

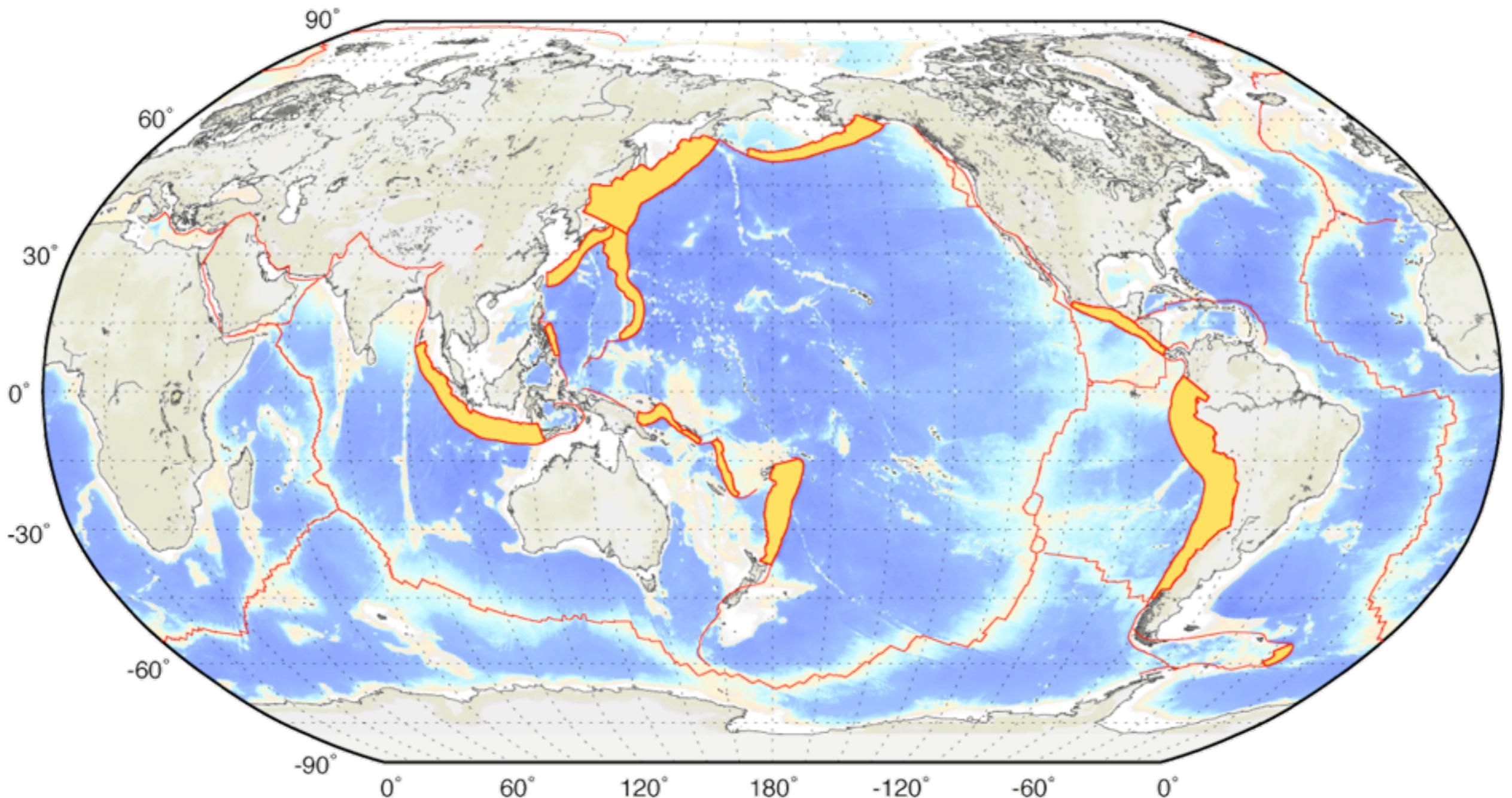
Exploring Controls on Seismogenesis

*Comparing Models of 3D Subduction Zone
Geometry with Source Inversions of Large
Earthquakes*

Gavin P. Hayes & David J. Wald
USGS NEIC

SSA 2011

Slab1.0 - Global Subduction Zone Model

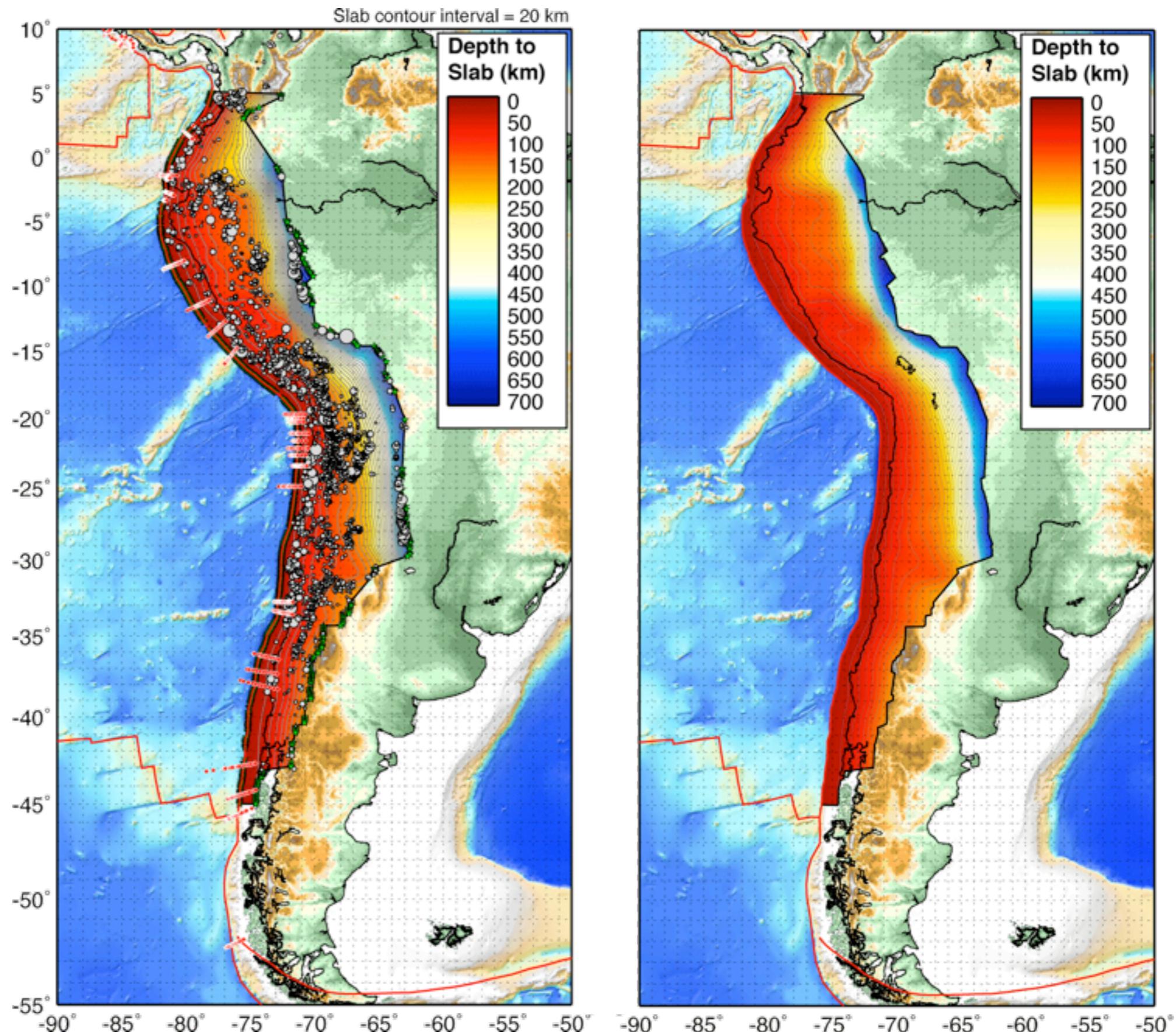


Currently covers ~85% of global subduction zones.
Fully 3D, non-planar models from the trench to the deep mantle.

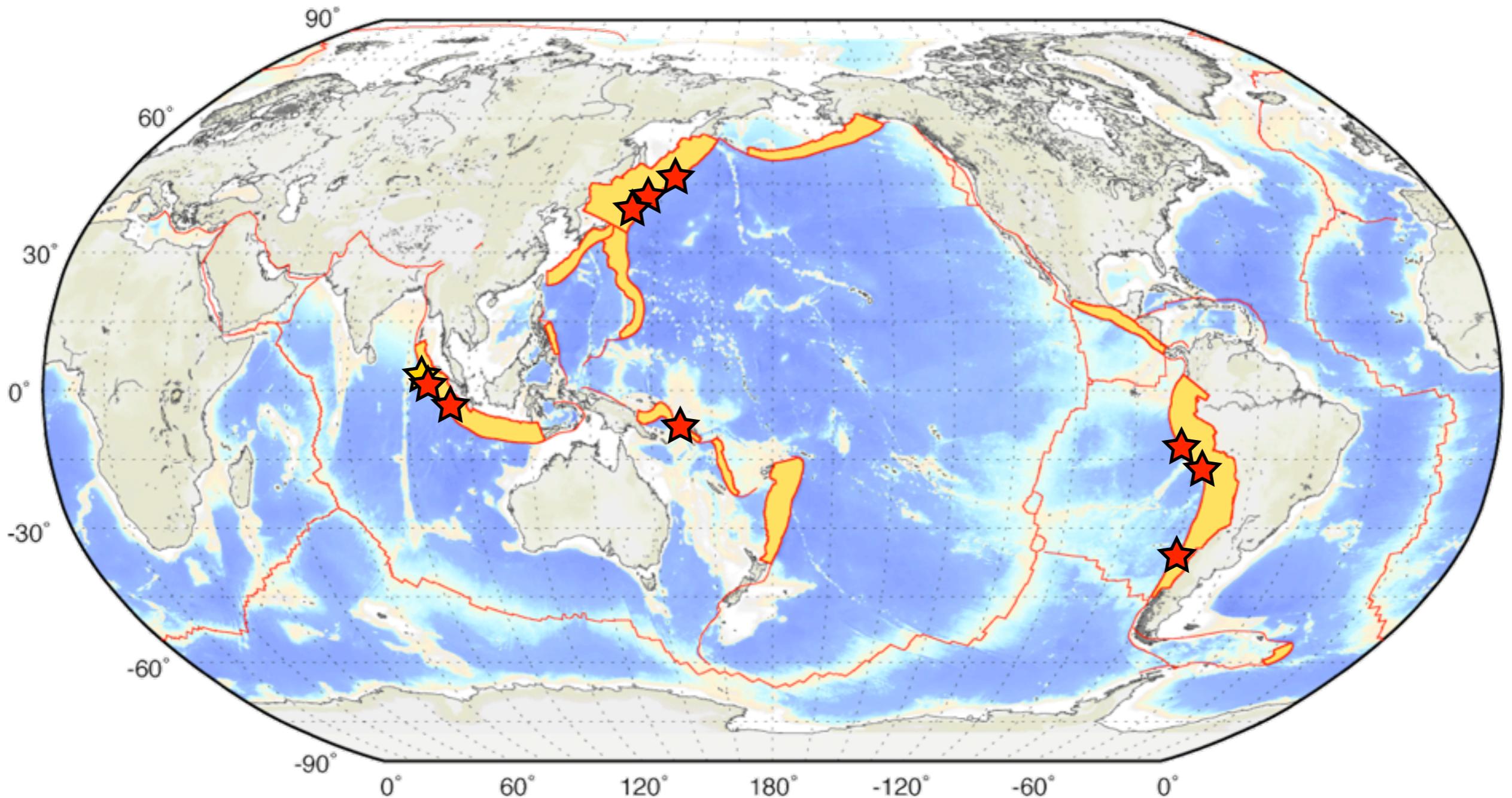
South America Slab

Grey circles =
Subduction zone
EQs used for
geometry
constraint
(post-data
filter).

Red diamonds =
active seismic
data profile
interpretations
of shallow slab.



Slab1.0 vs Moment Release - Great EQ Ruptures



Compare slab geometry with along-strike coseismic moment release of great subduction zone earthquakes of the 21st century.

Using teleseismic rupture models.

Exploring the Limits of the Seismogenesis

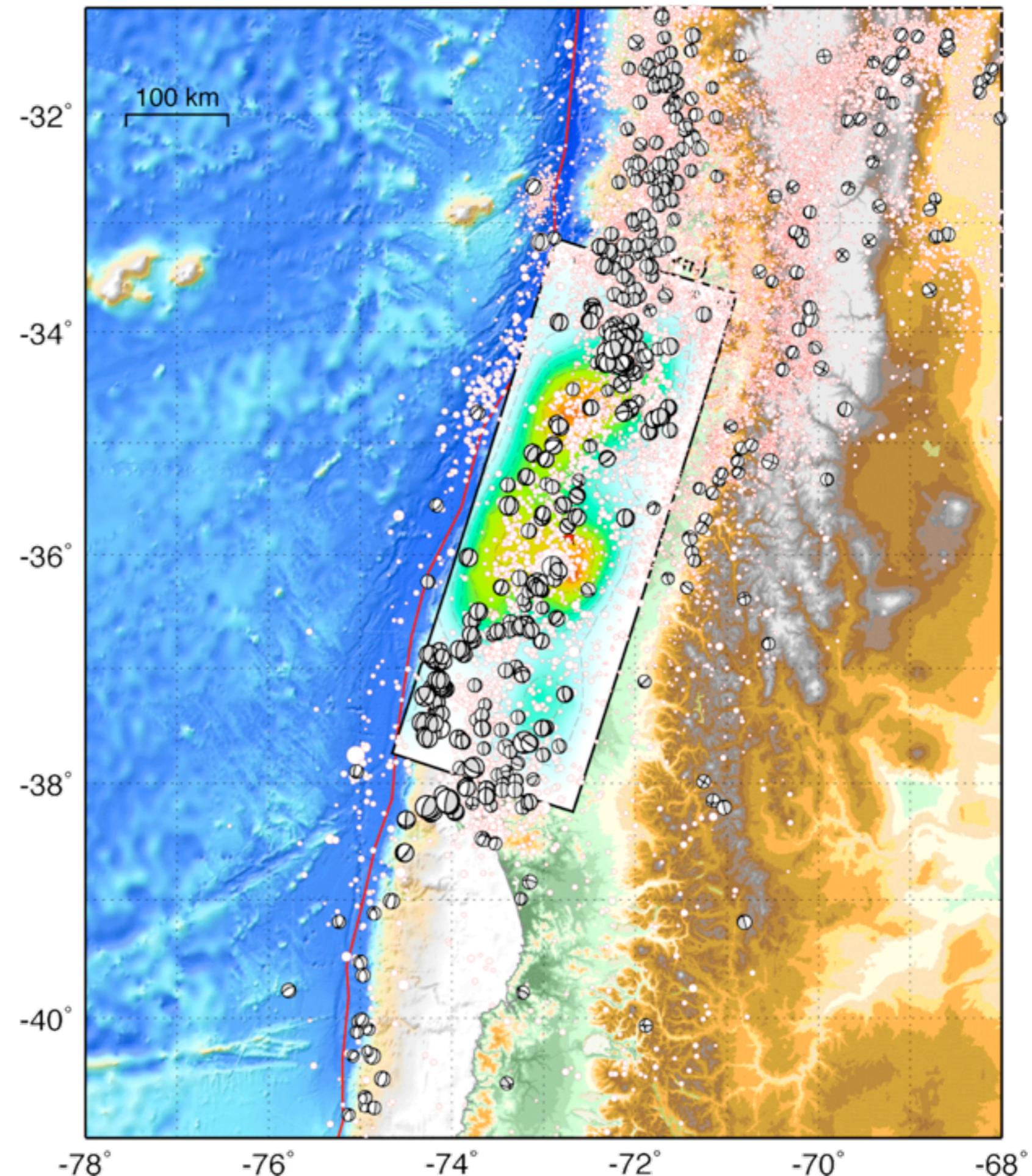
- Using Slab1.0 -

Maule EQ, 02/27/2010

White, red outline:
All PDE EQs in region,
1973-present.

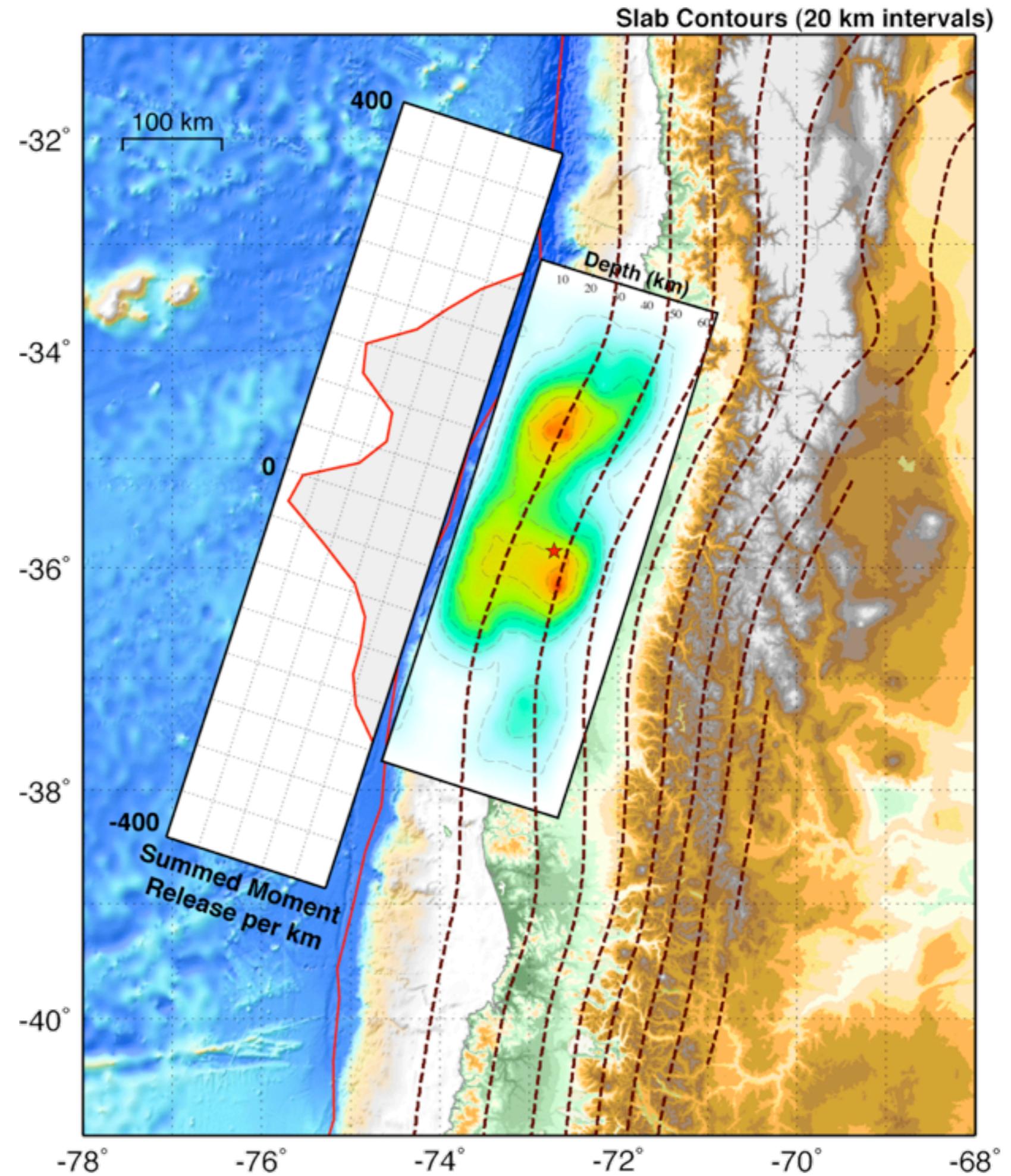
Light grey CMTs: All
gCMT mechanisms in
region (1976-present),
plus regional moment
tensors of aftershocks
using IRIS CHAMP
data.

Bilateral rupture;
two major asperities
along strike, one near
hypocenter to south,
one to north and up-
dip.



Maule EQ, NEIC FFM vs Slab Structure

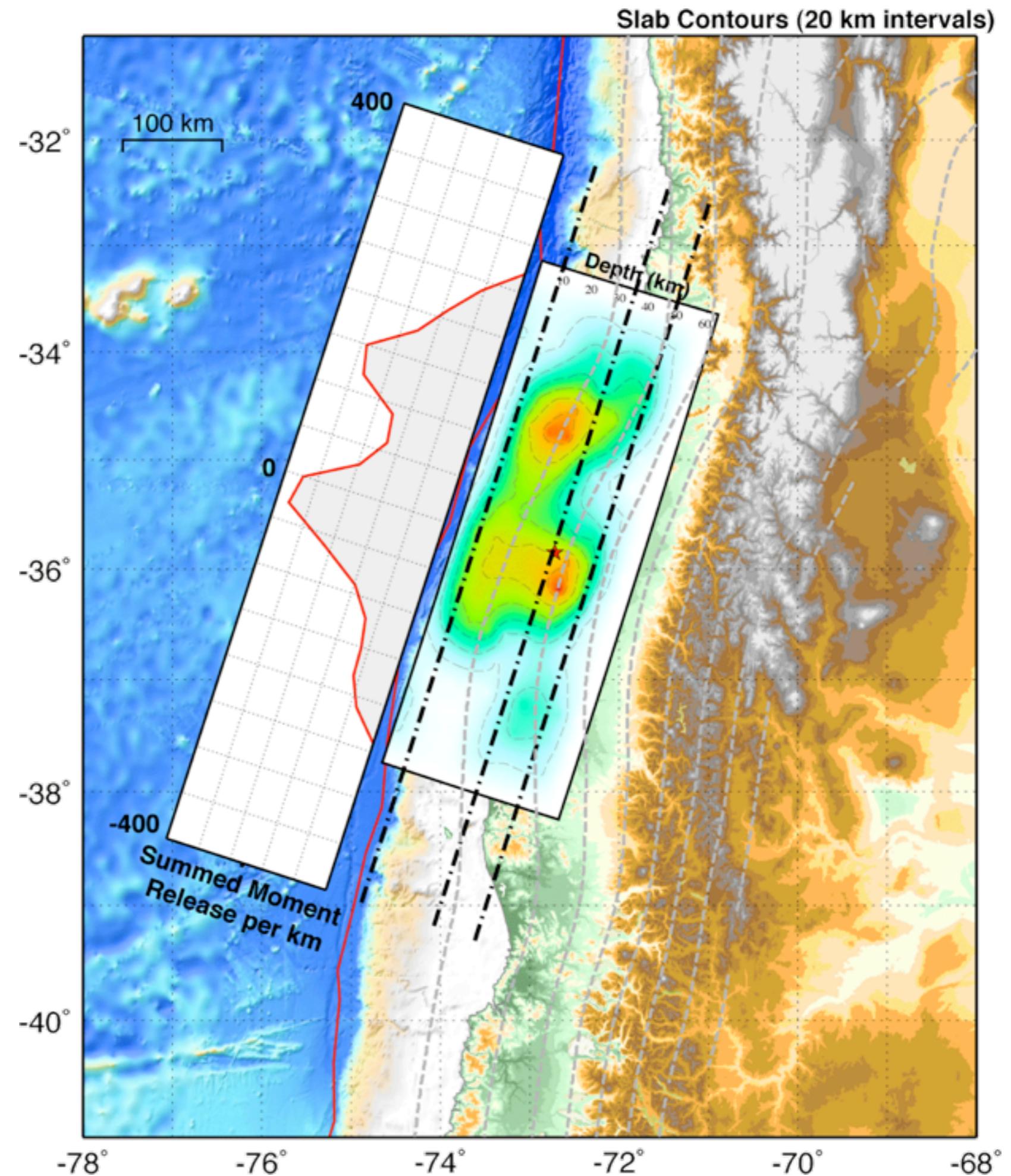
Using a 1D cross-section of the slip distribution, assess correlations between FFM and slab structure (strike, dip, depth).



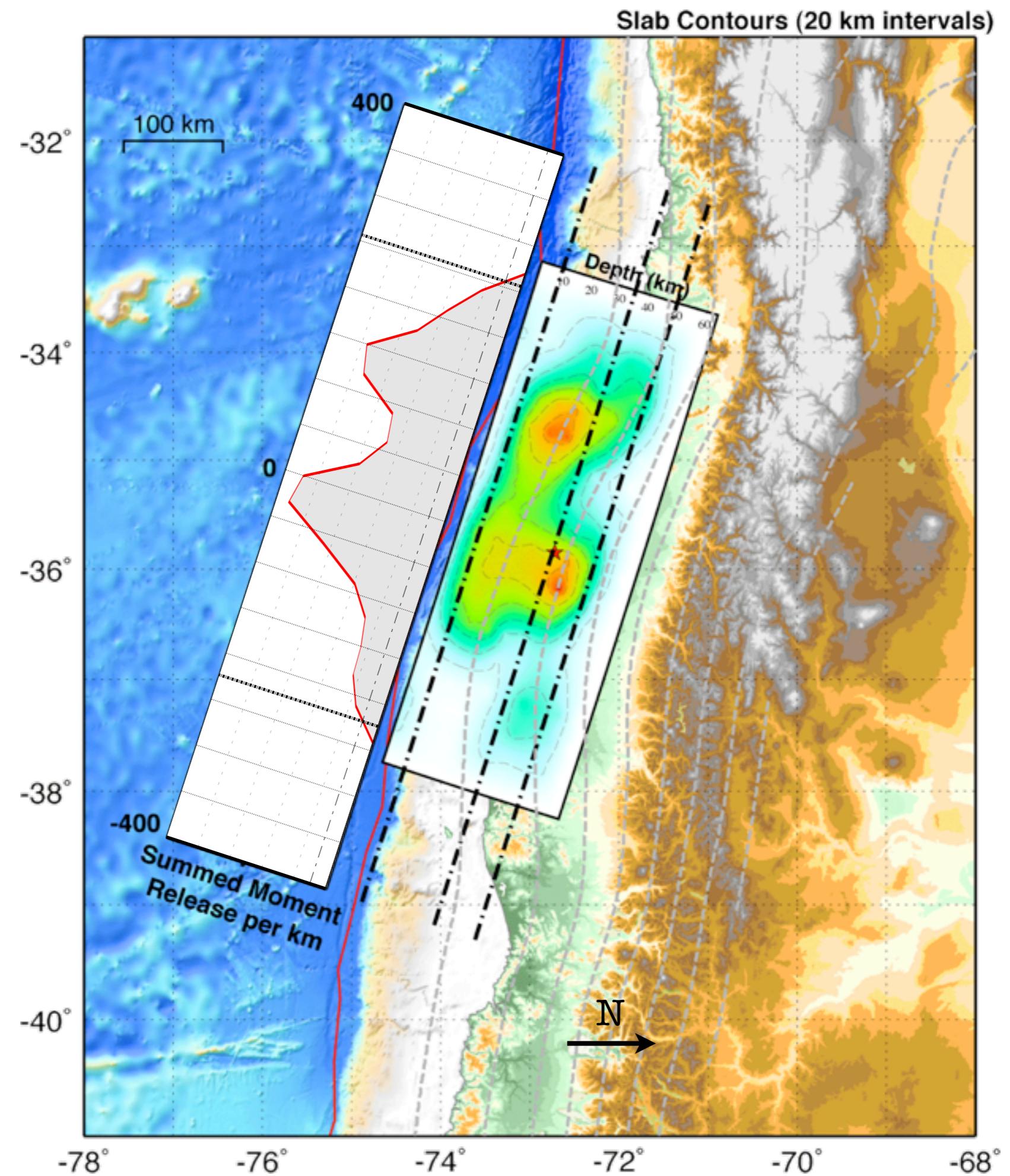
Maule EQ, NEIC FFM vs Slab Structure

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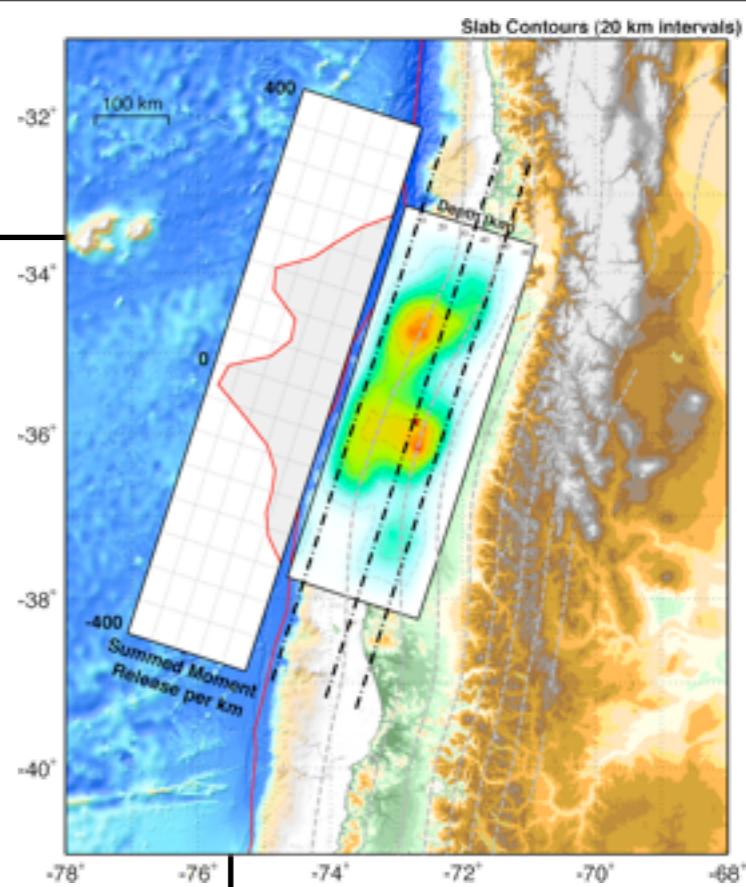
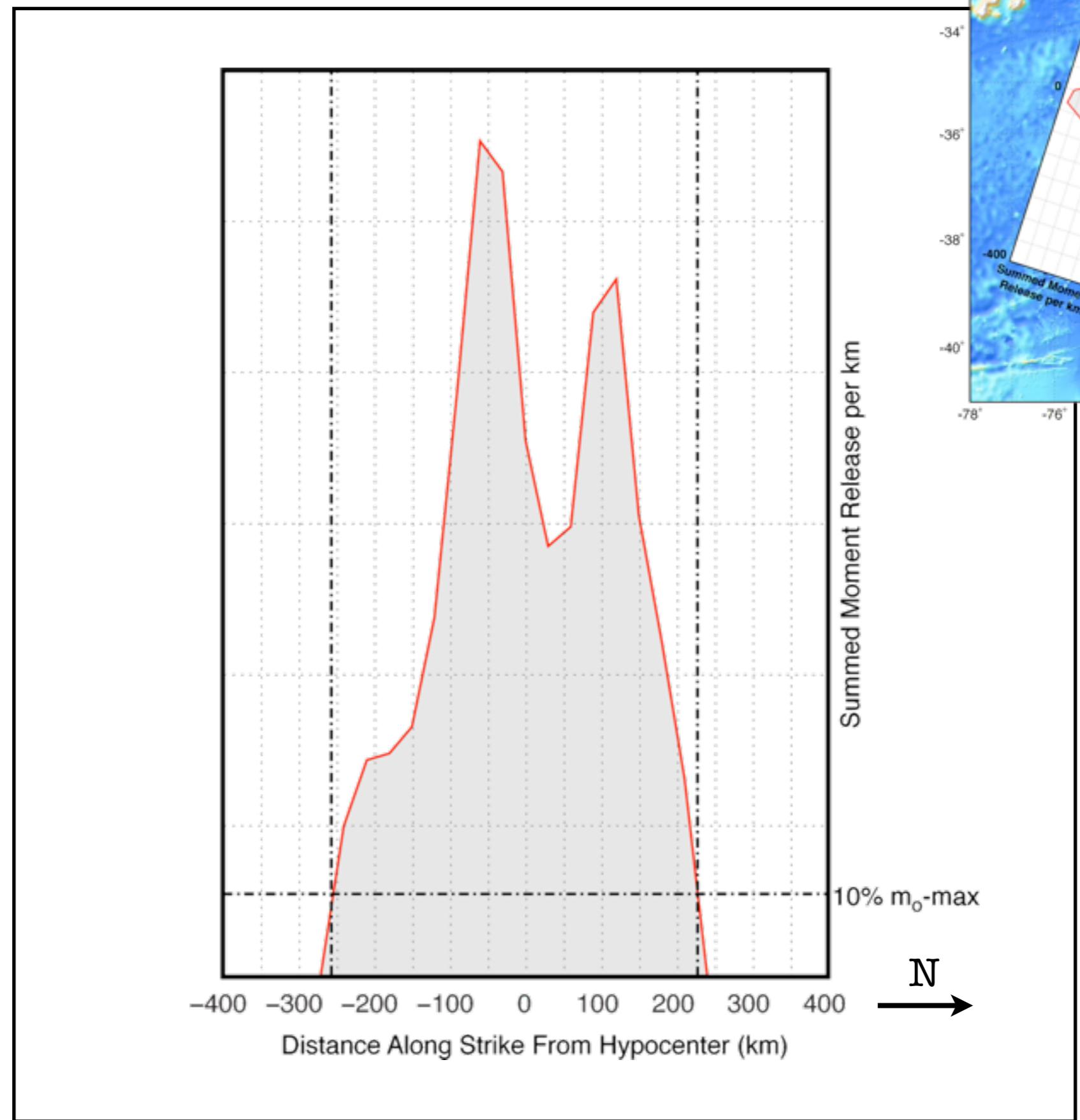
View structure along three profiles; through hypocenter and at up- and down-dip limits of model slip.



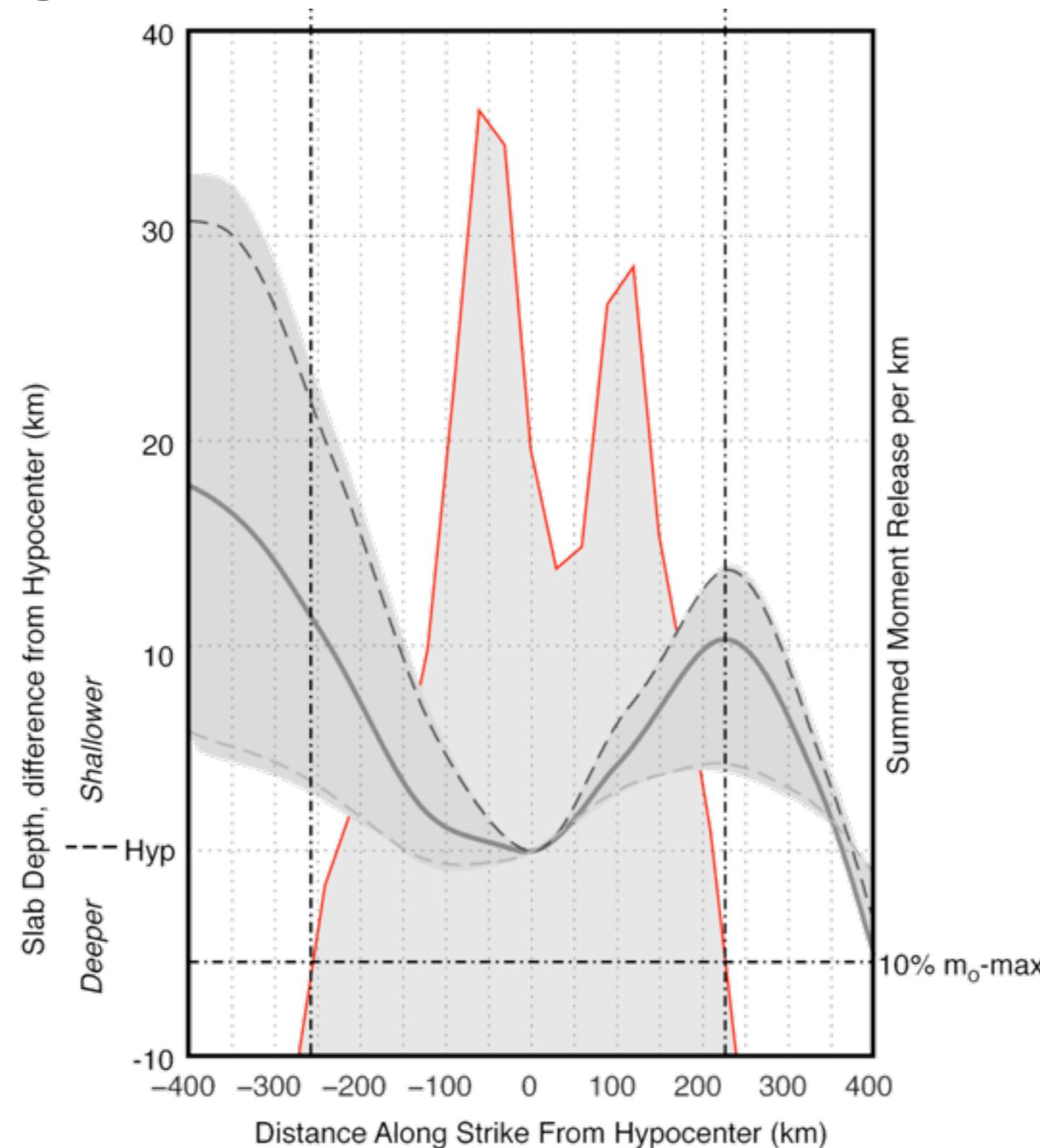
FFM vs Slab



FFM vs Slab

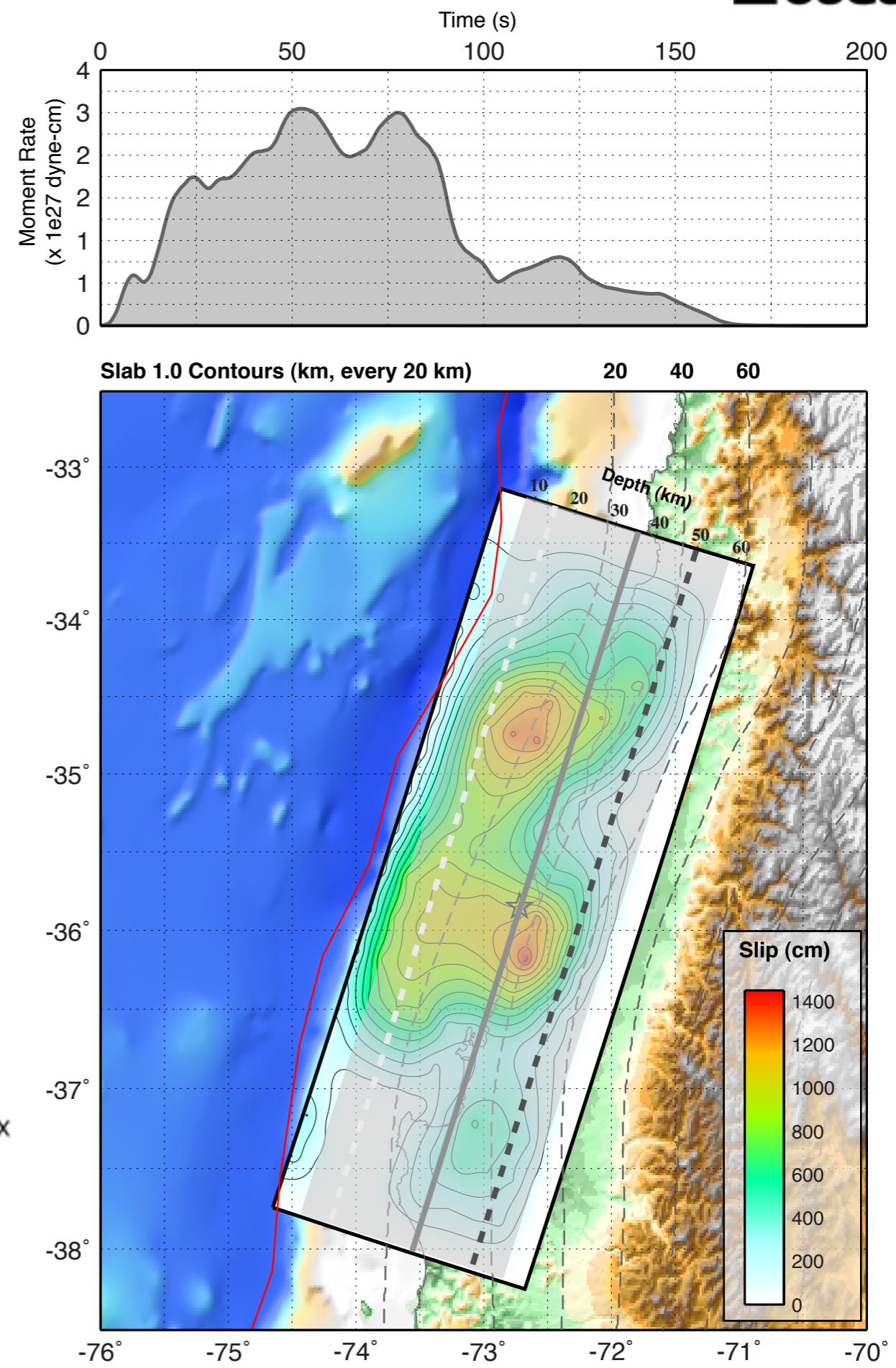
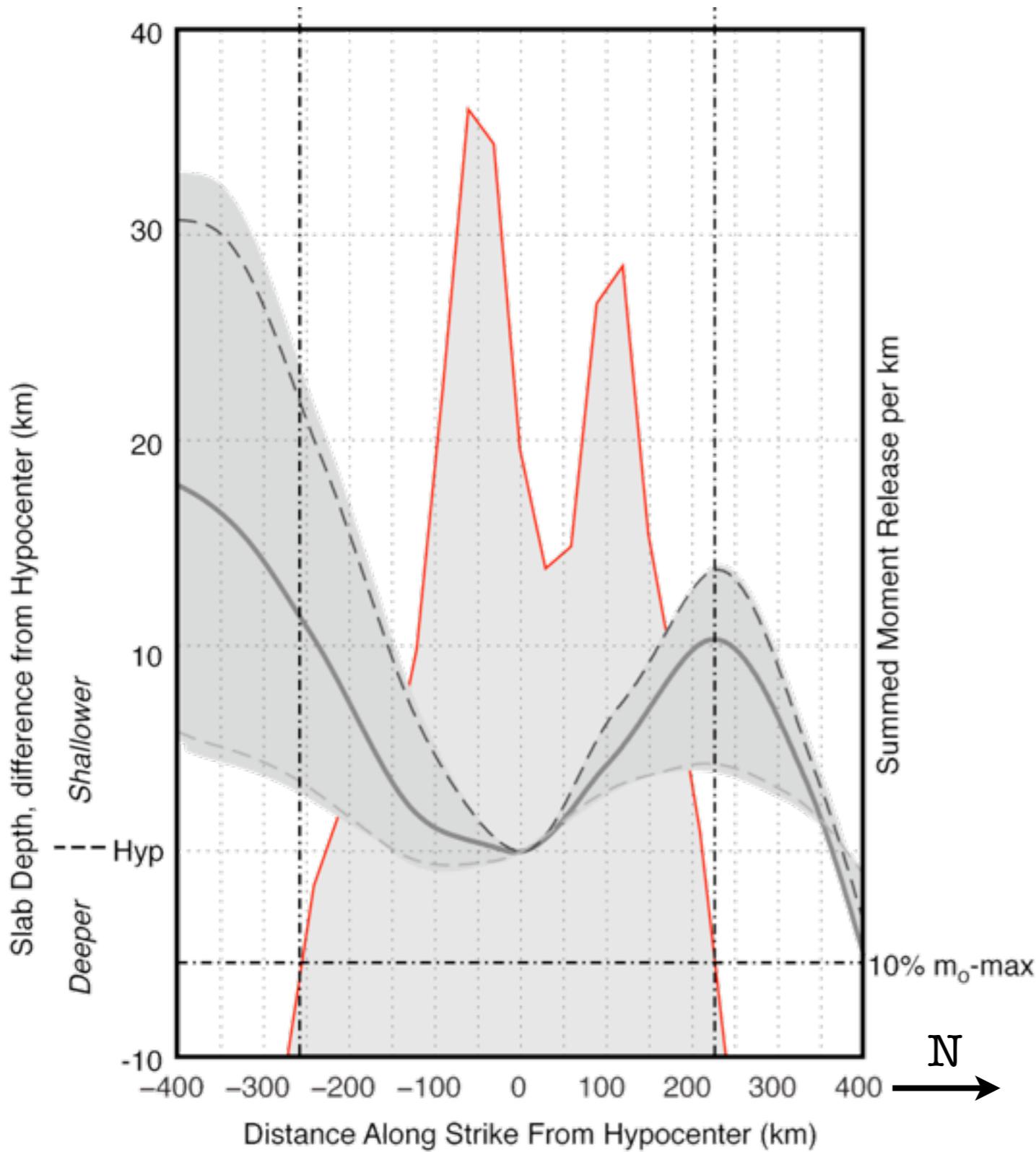


FFM vs Slab Maule 2010

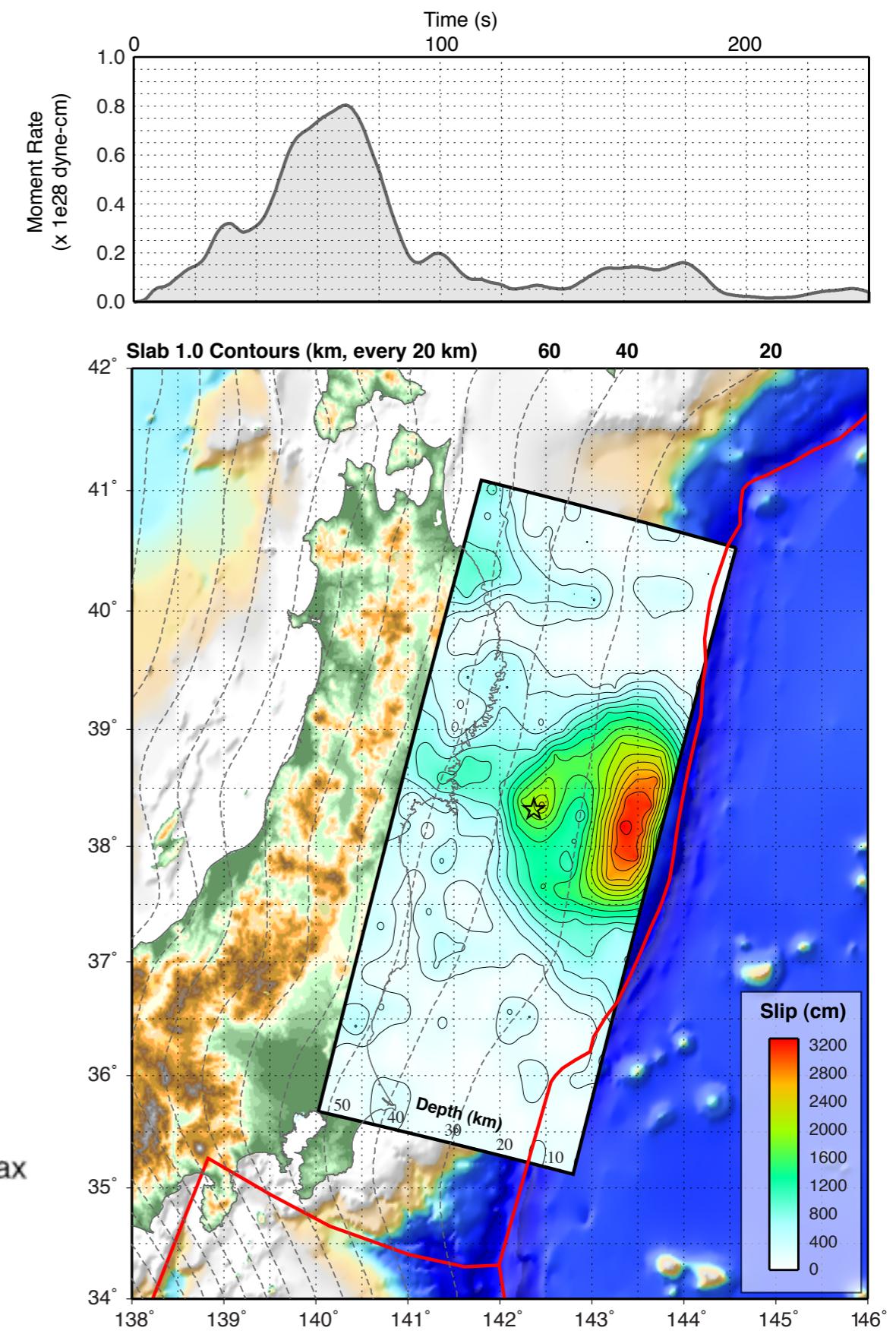
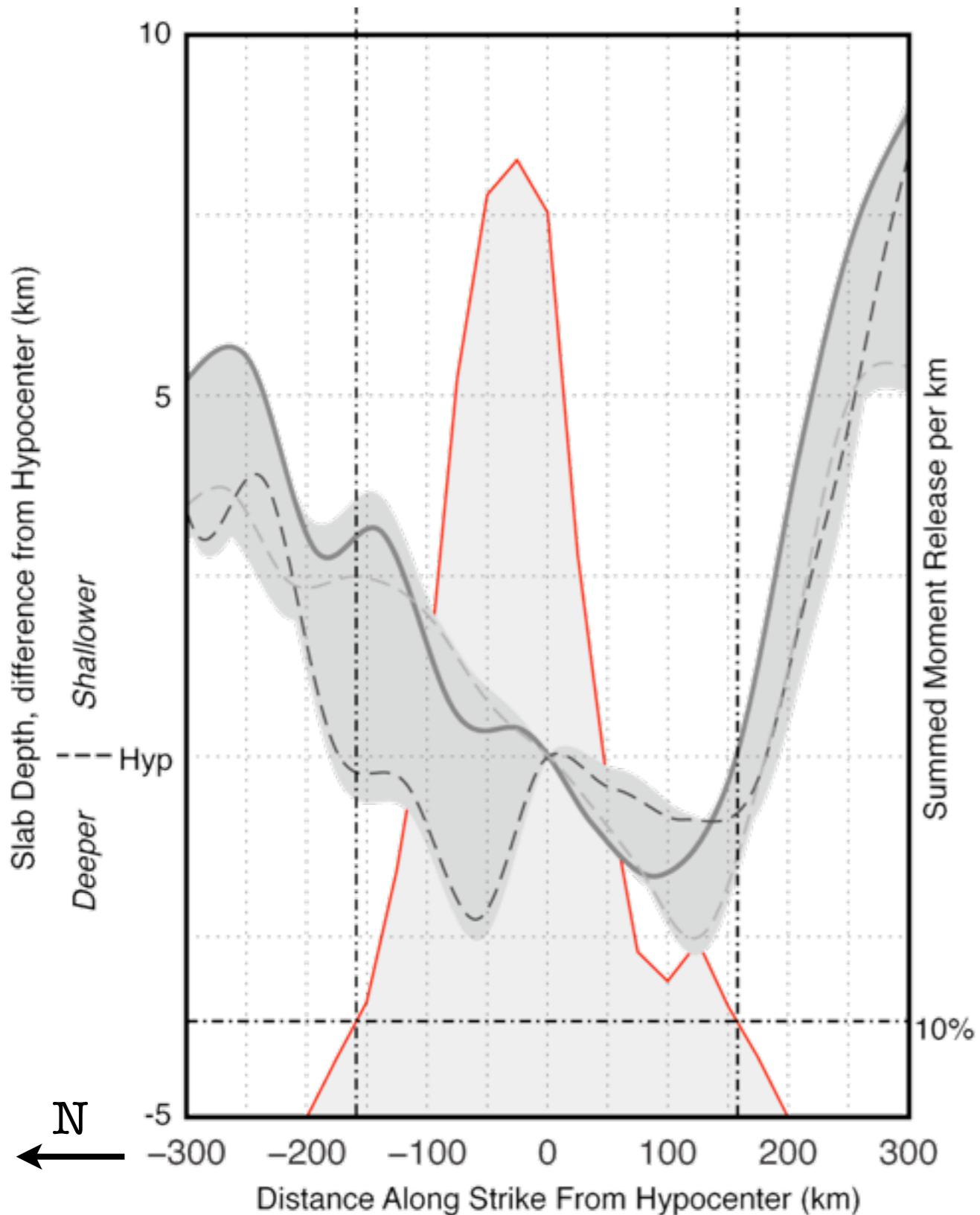


FFM vs Slab

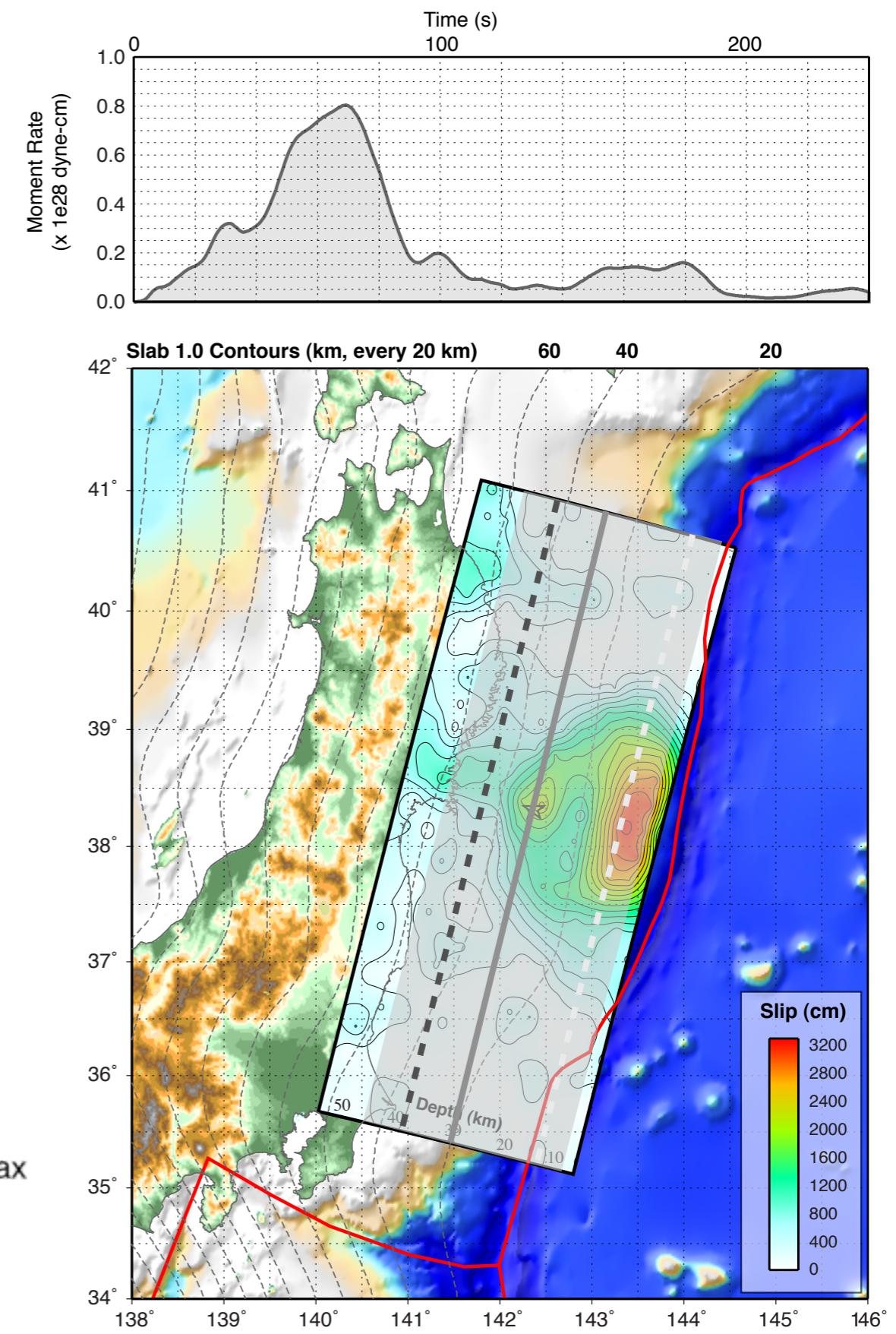
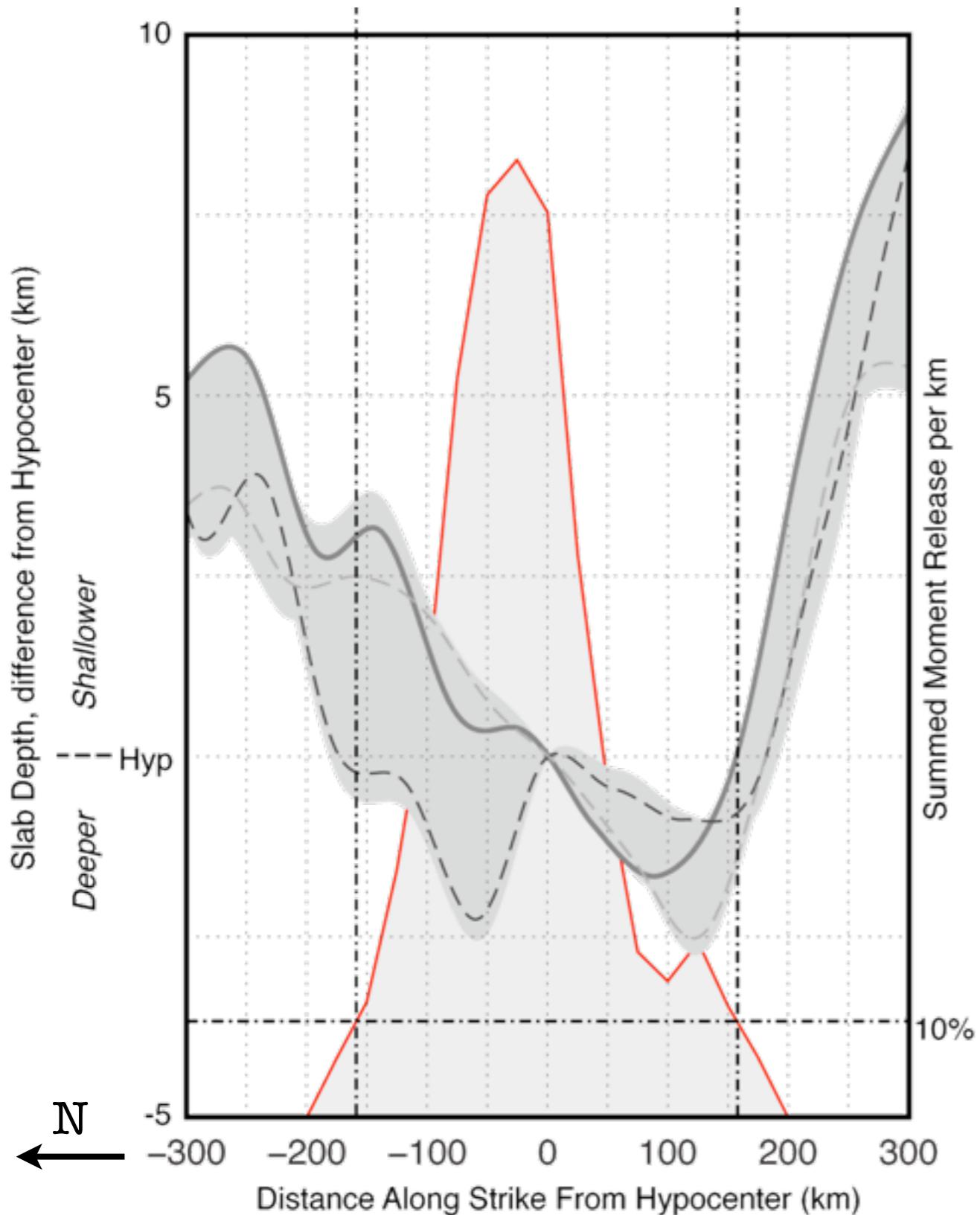
Maule 2010



FFM vs Slab Tohoku 2011

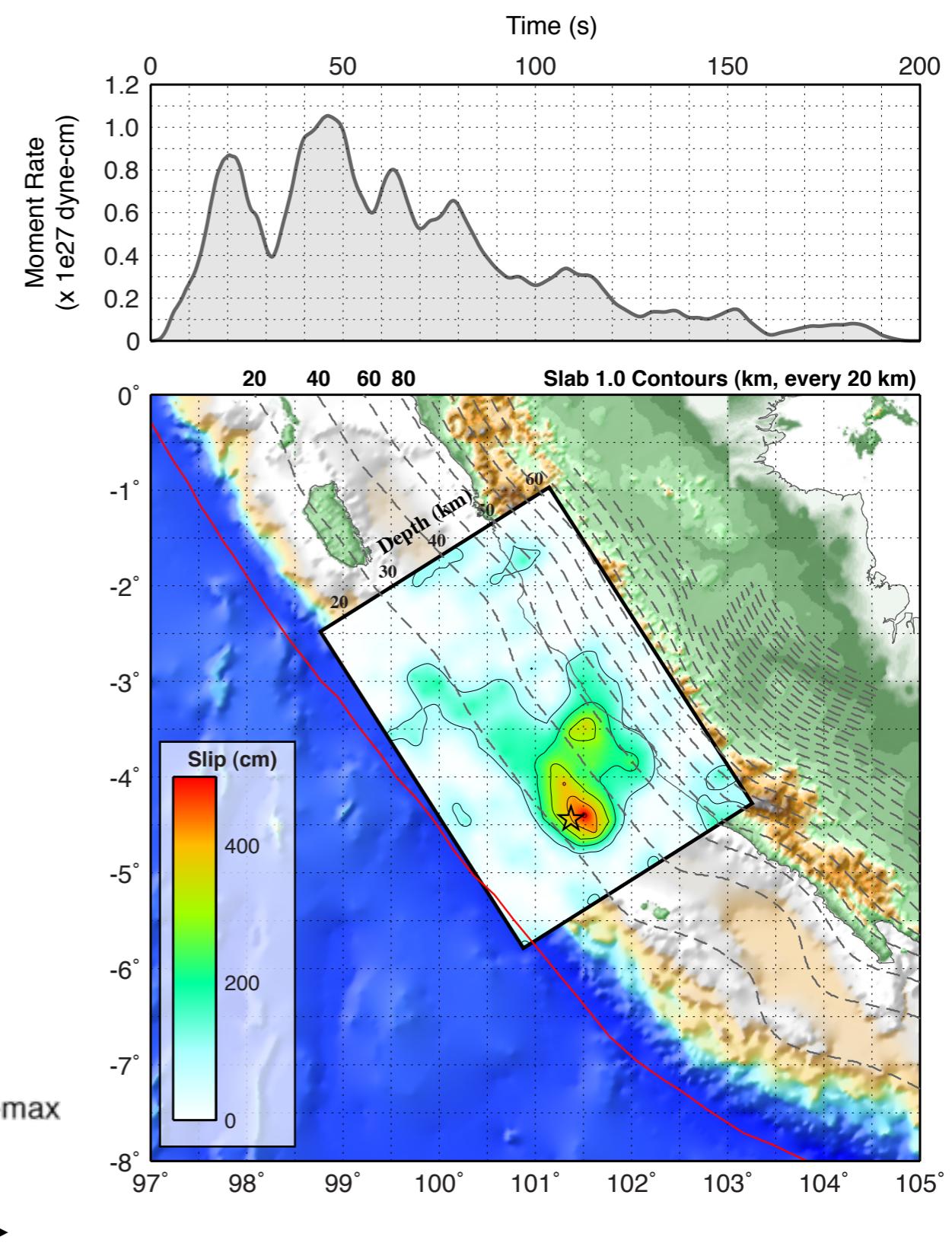
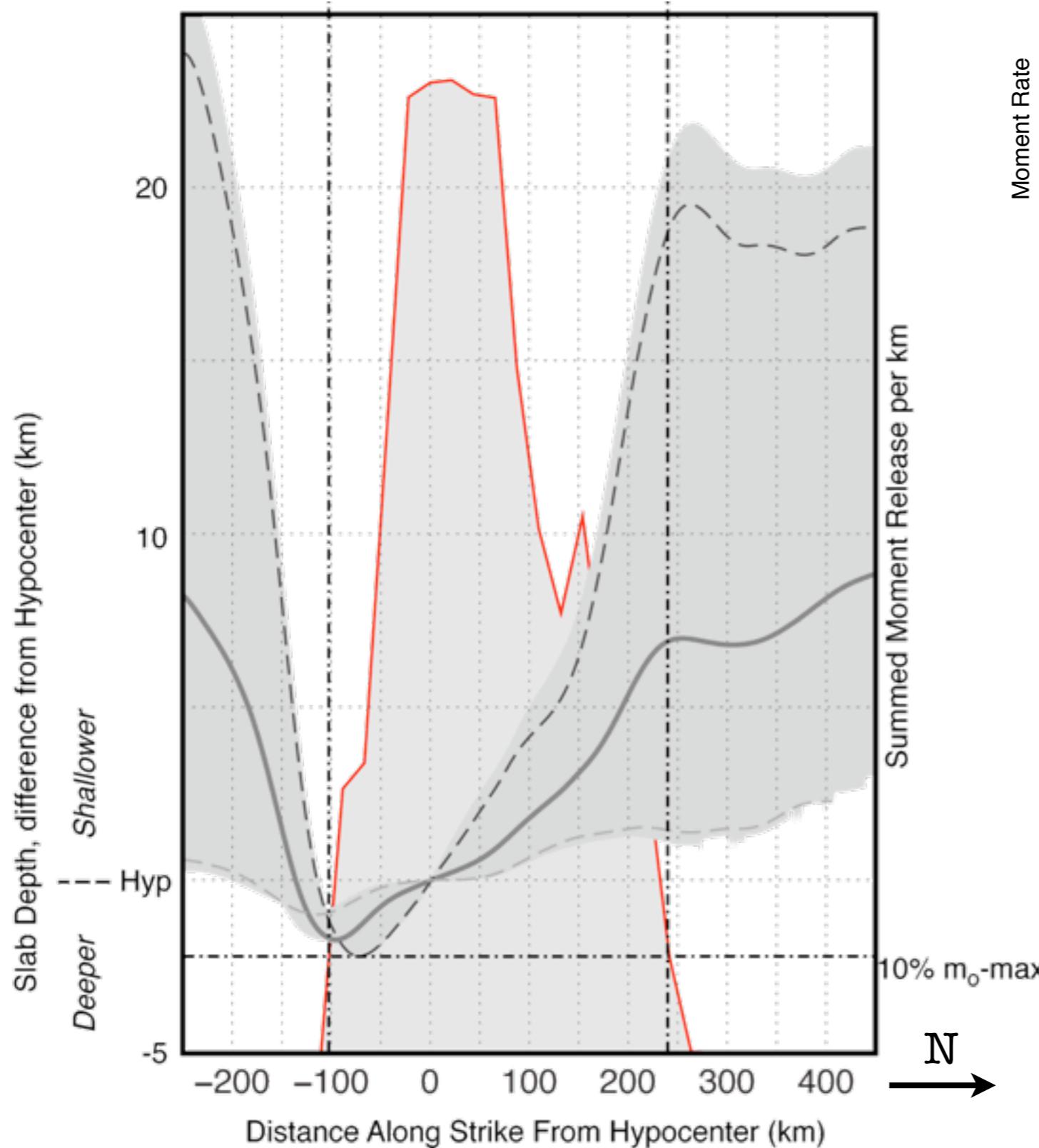


FFM vs Slab Tohoku 2011



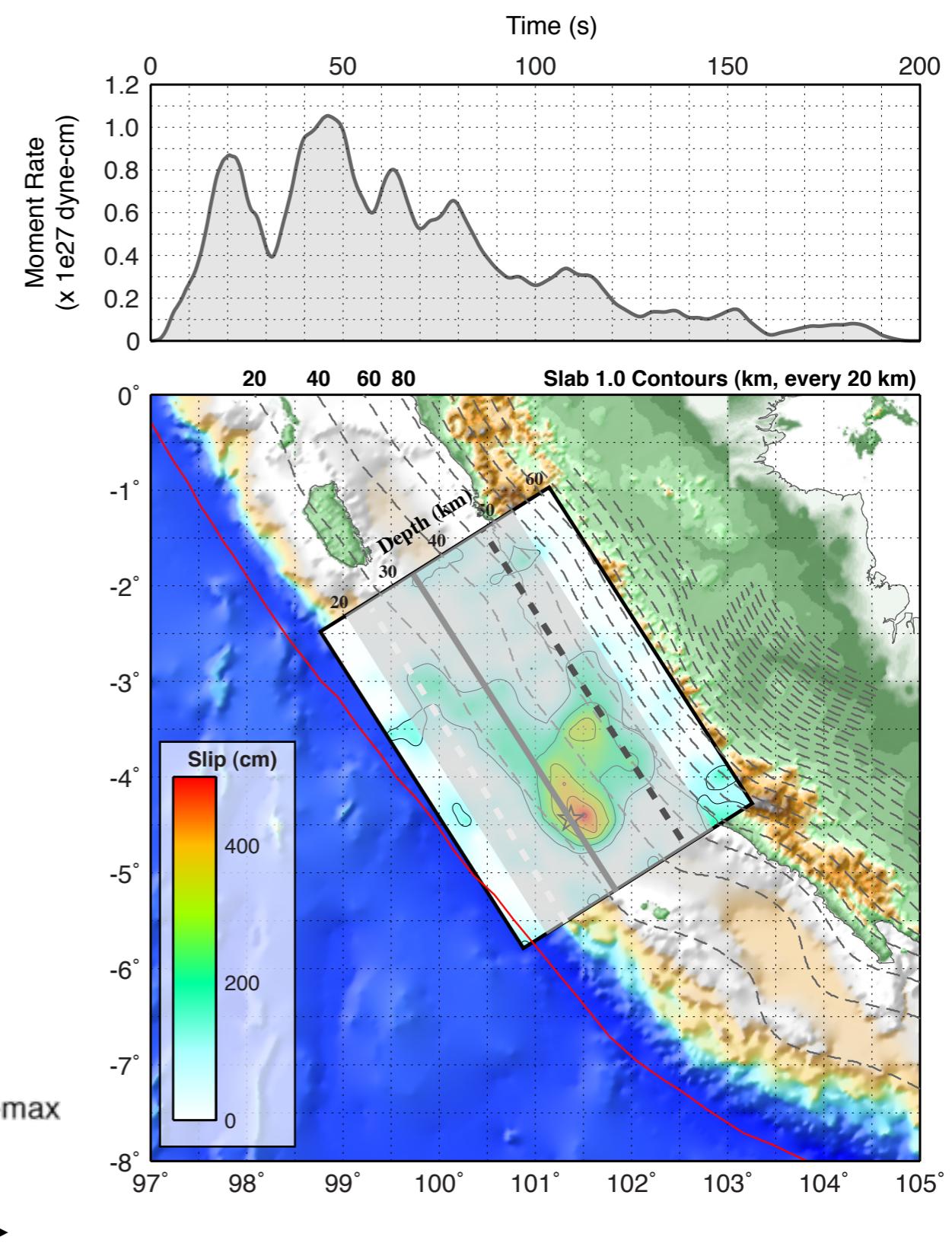
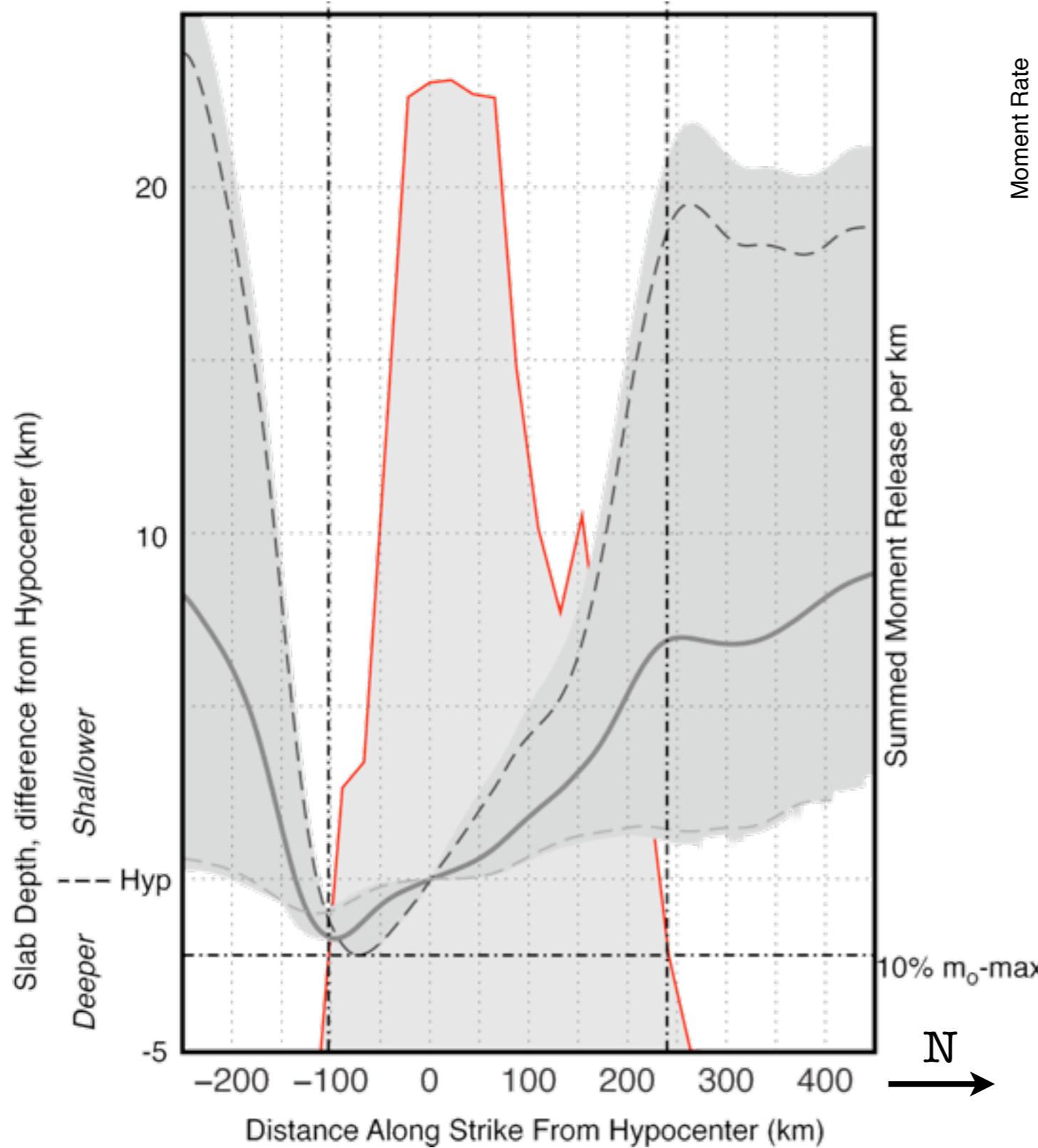
FFM vs Slab

Sumatra 2007 (09/12a)

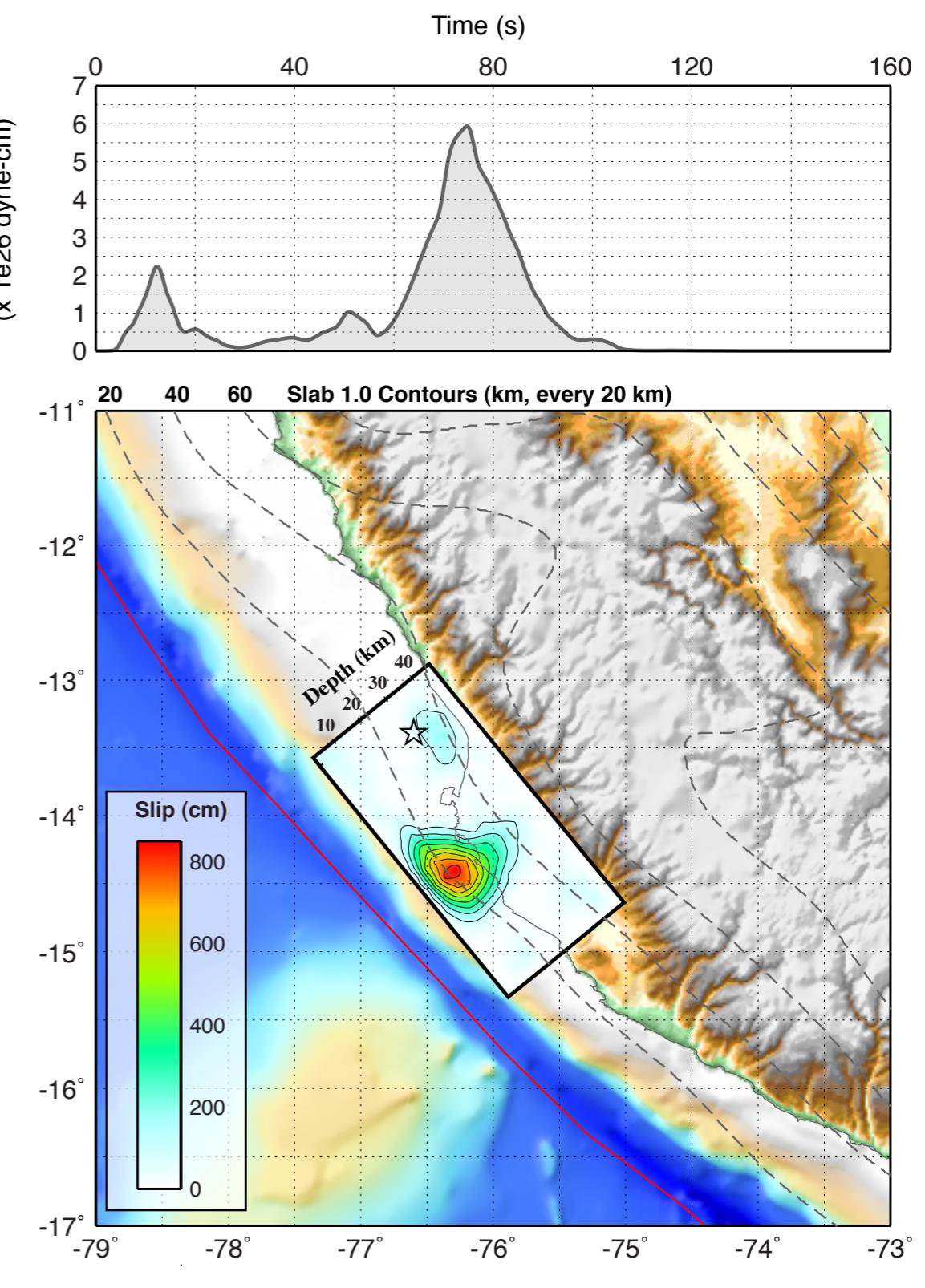
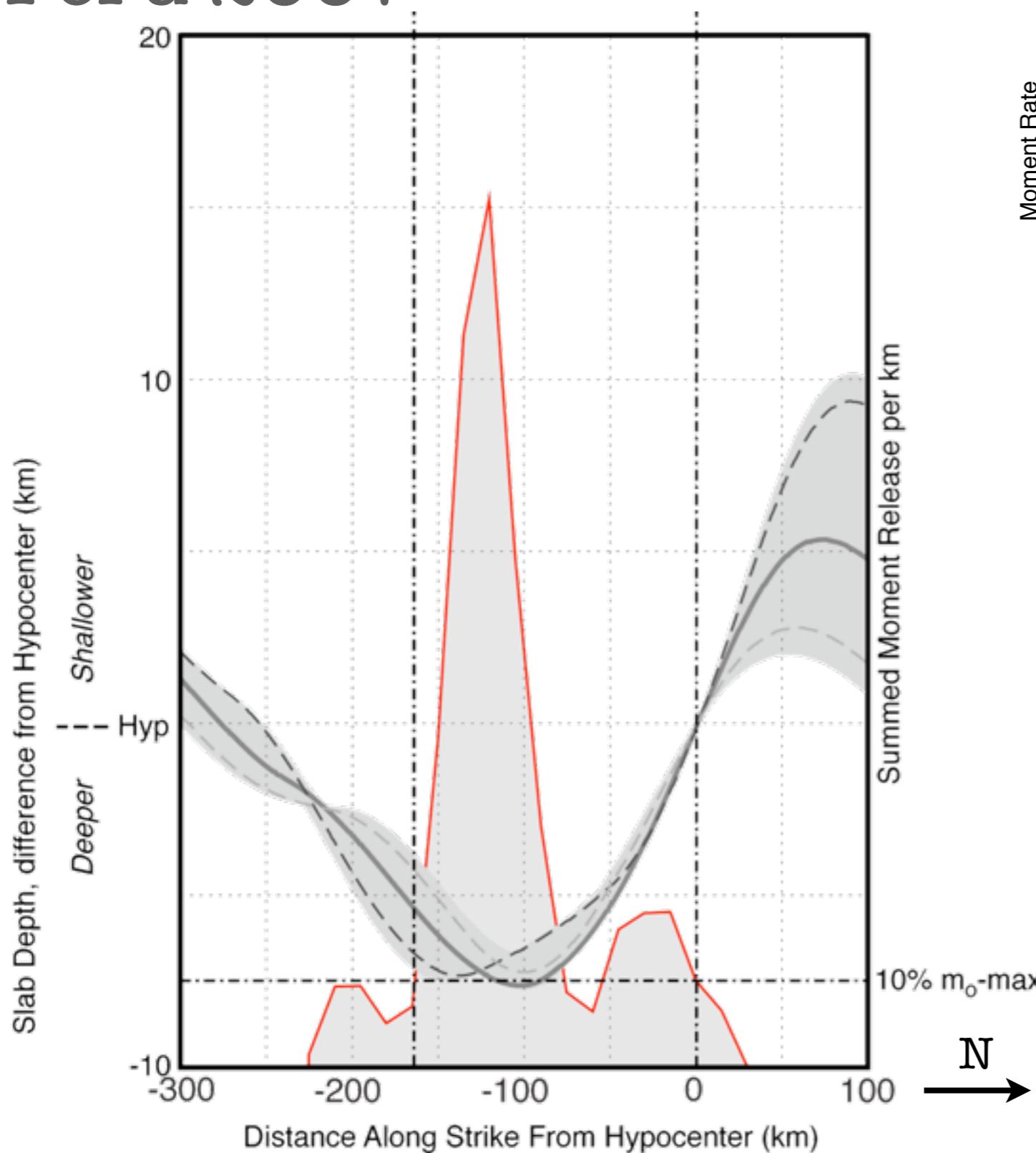


FFM vs Slab

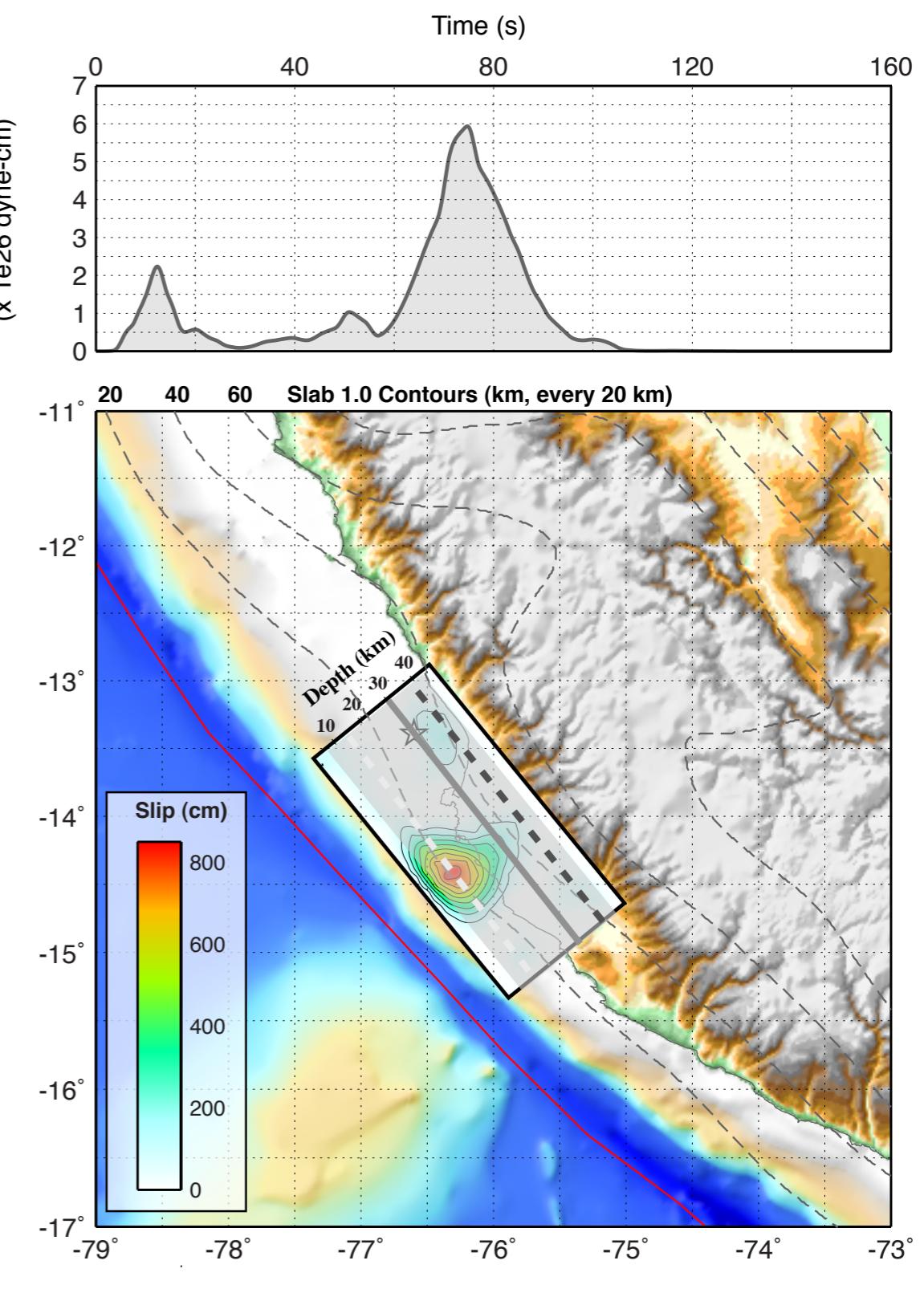
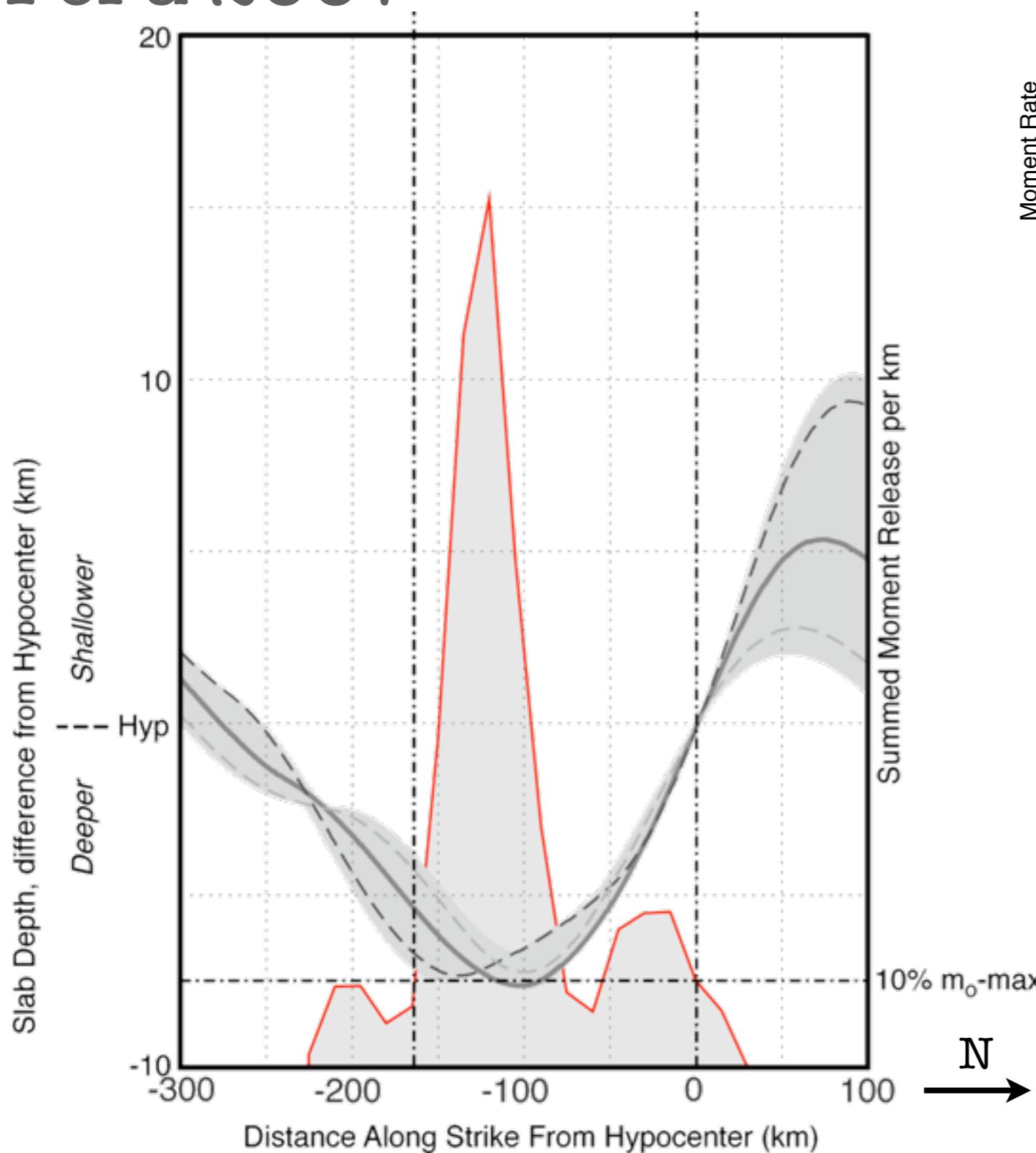
Sumatra 2007 (09/12a)



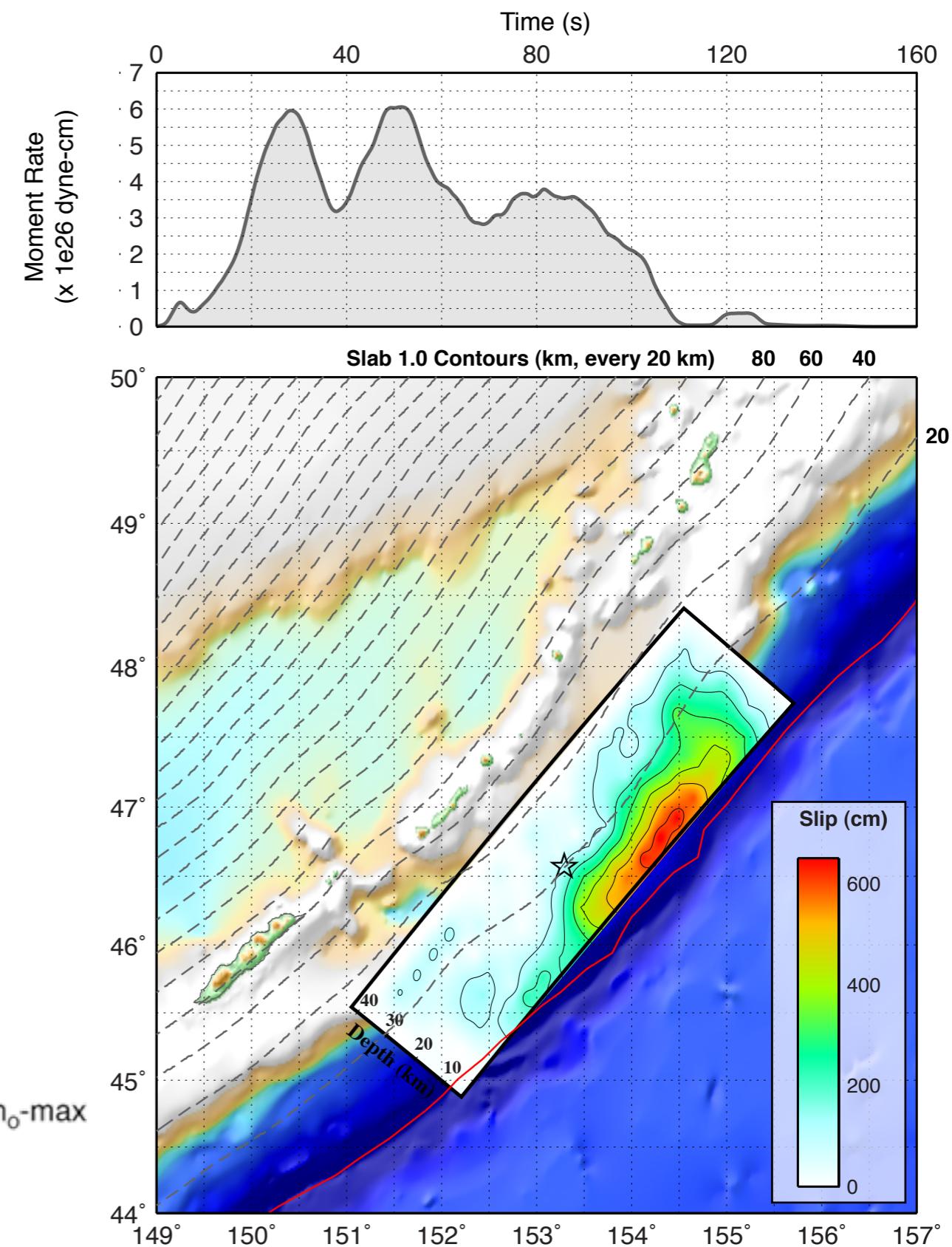
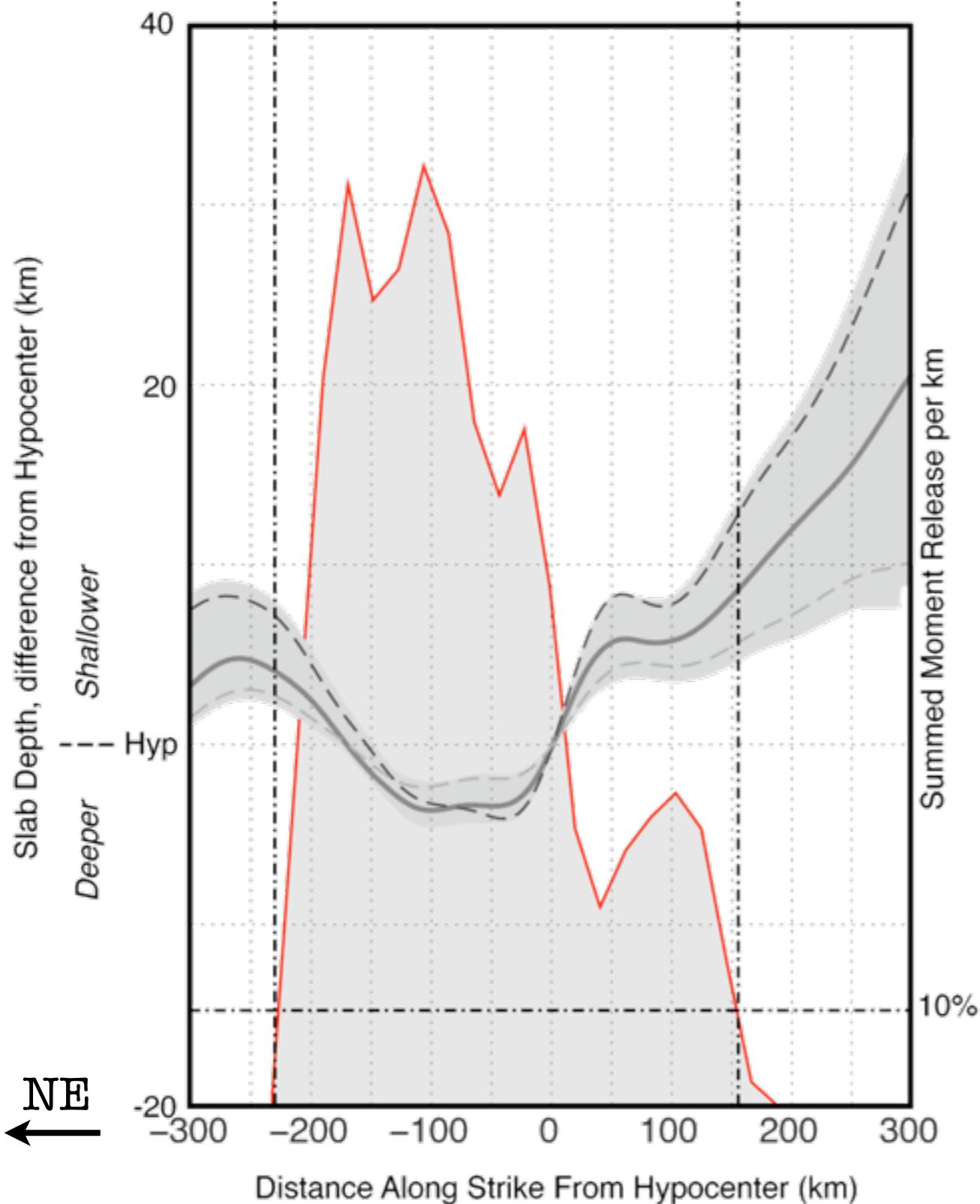
FFM vs Slab Peru 2007



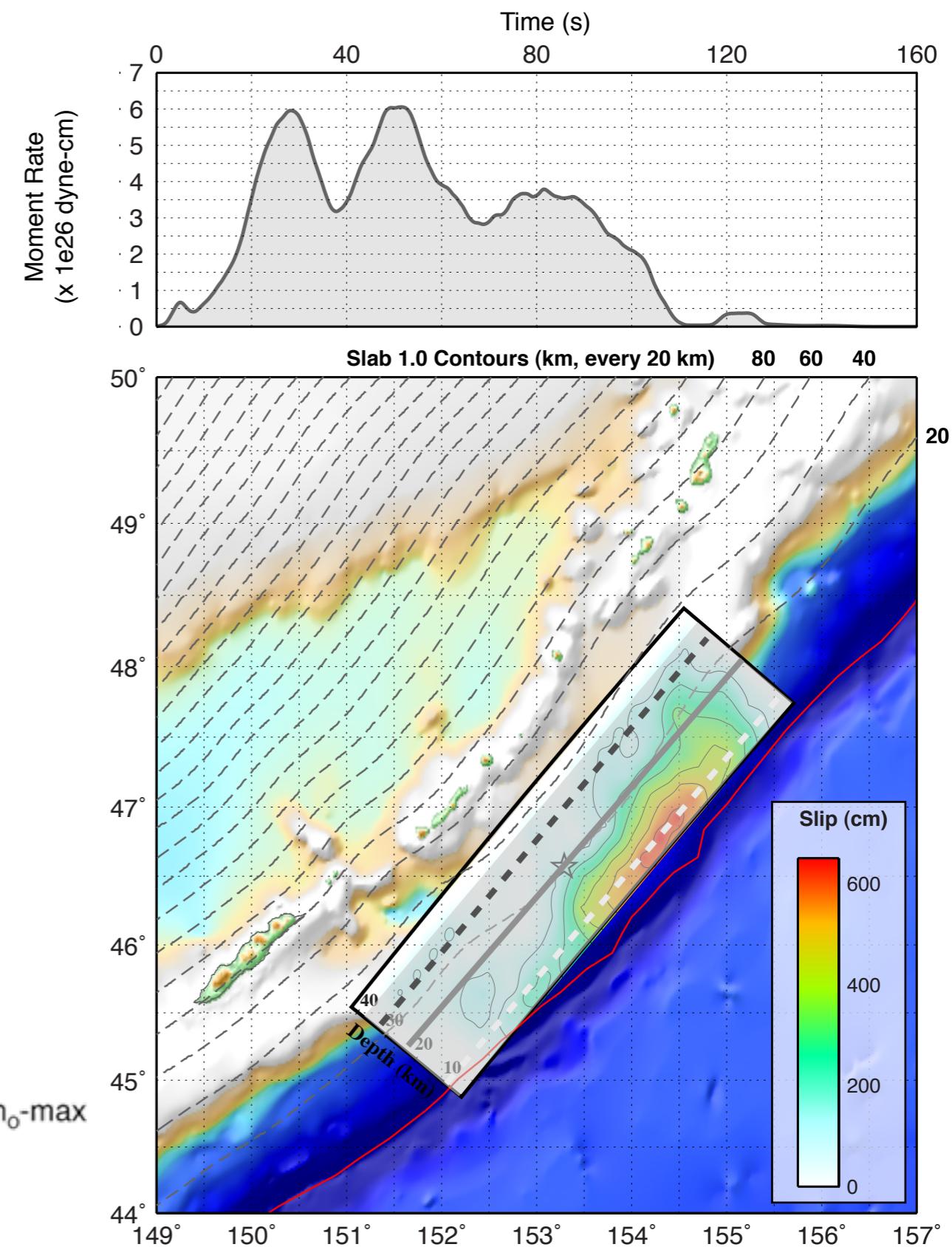
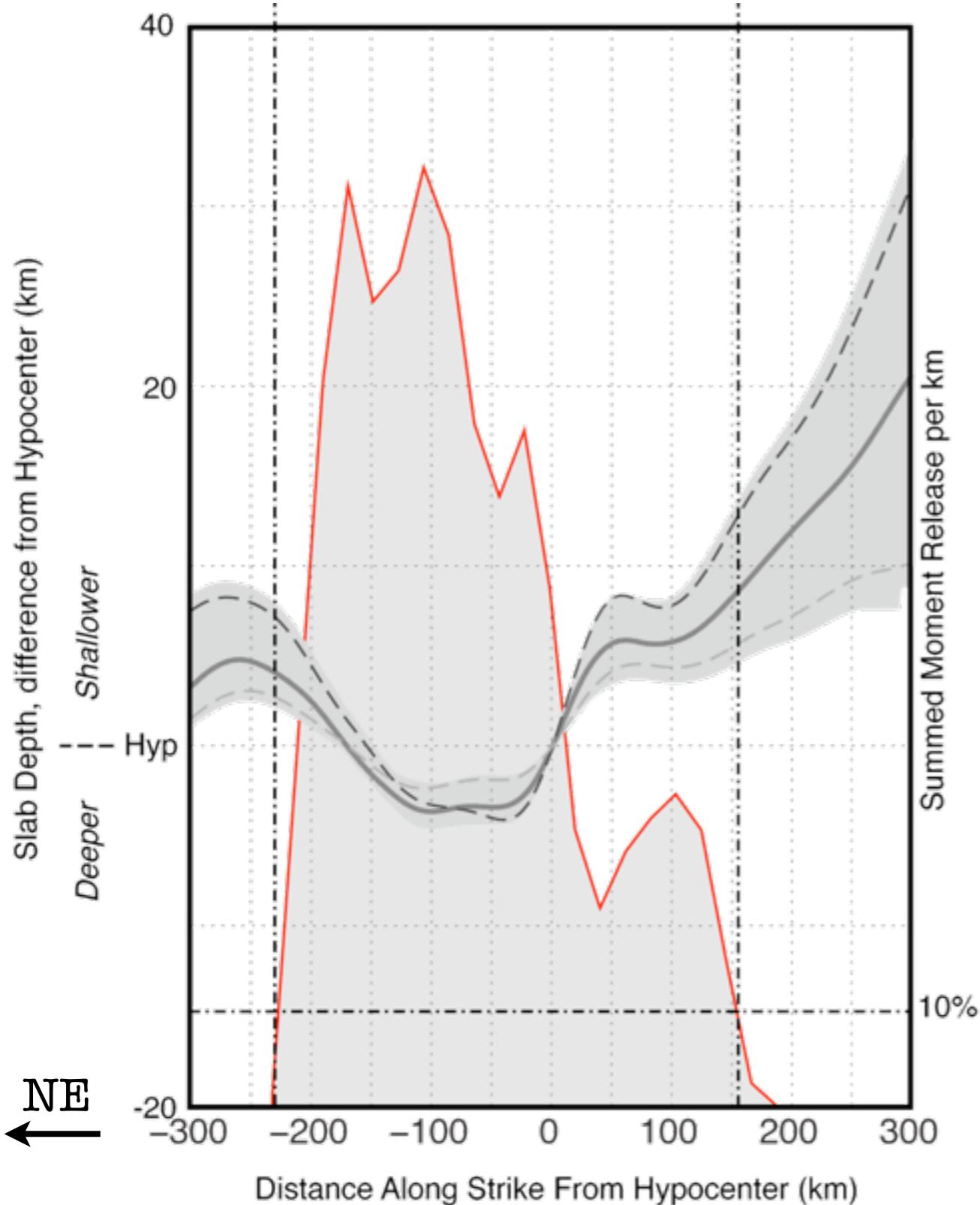
FFM vs Slab Peru 2007



FFM vs Slab Kurils 2006

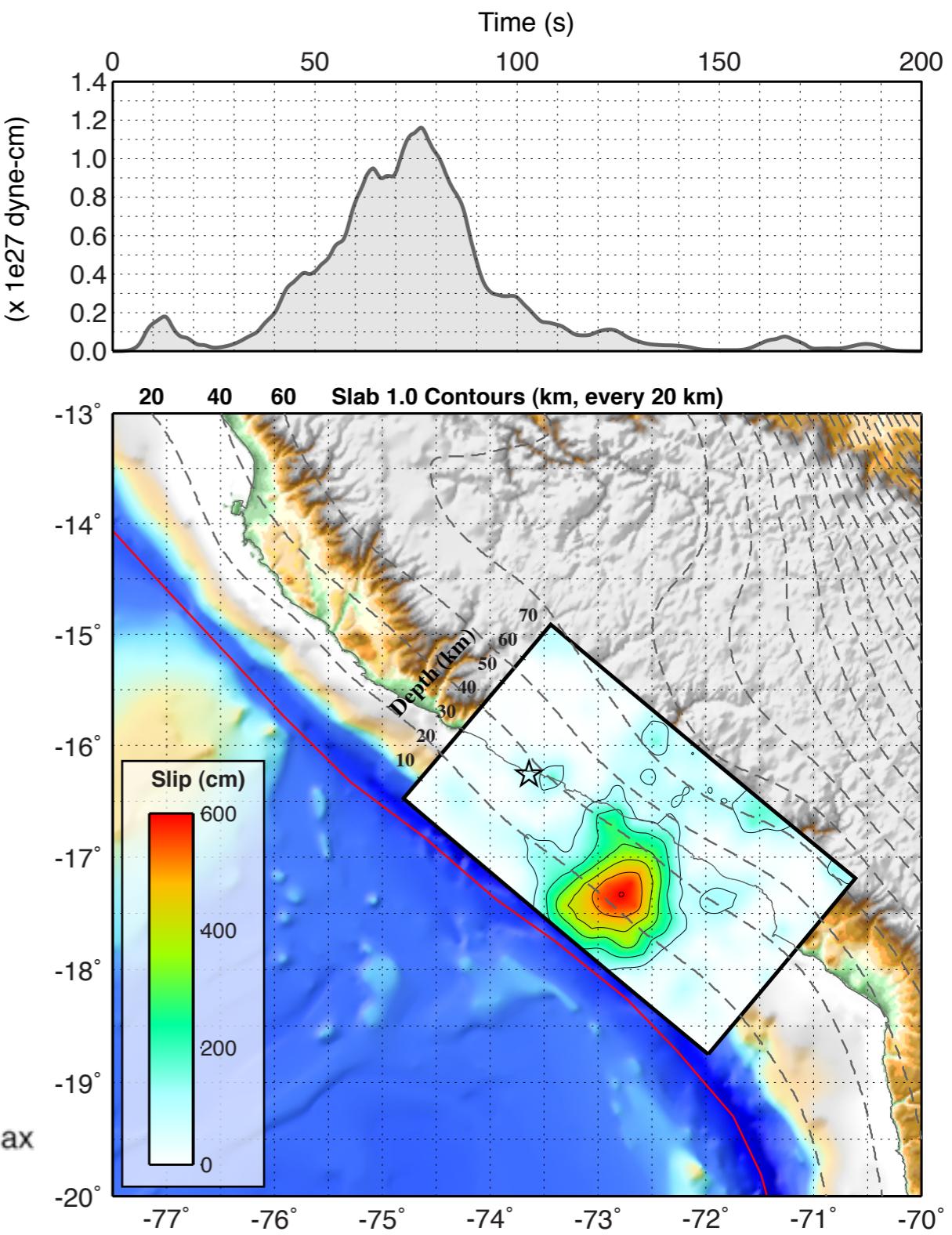
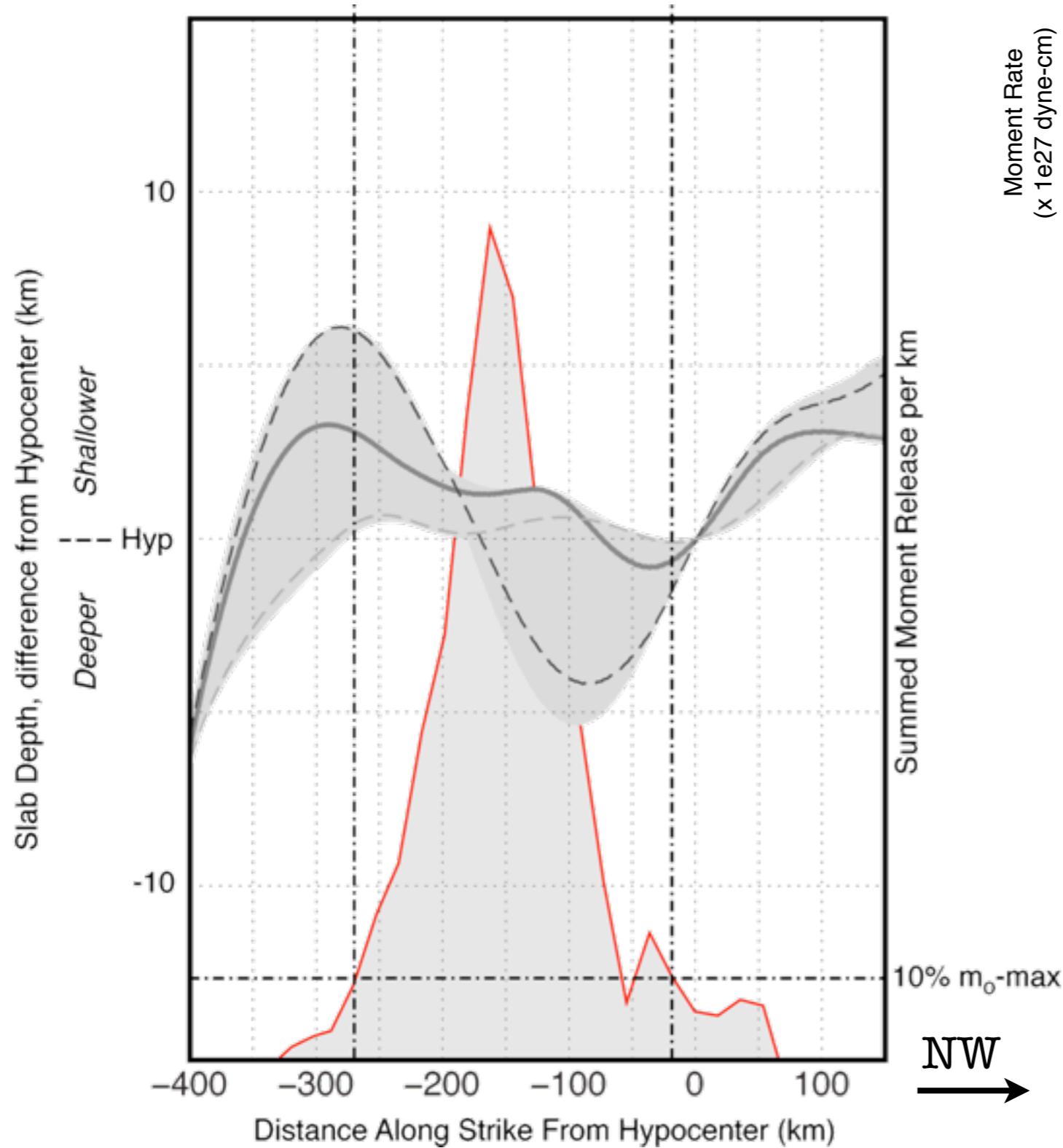


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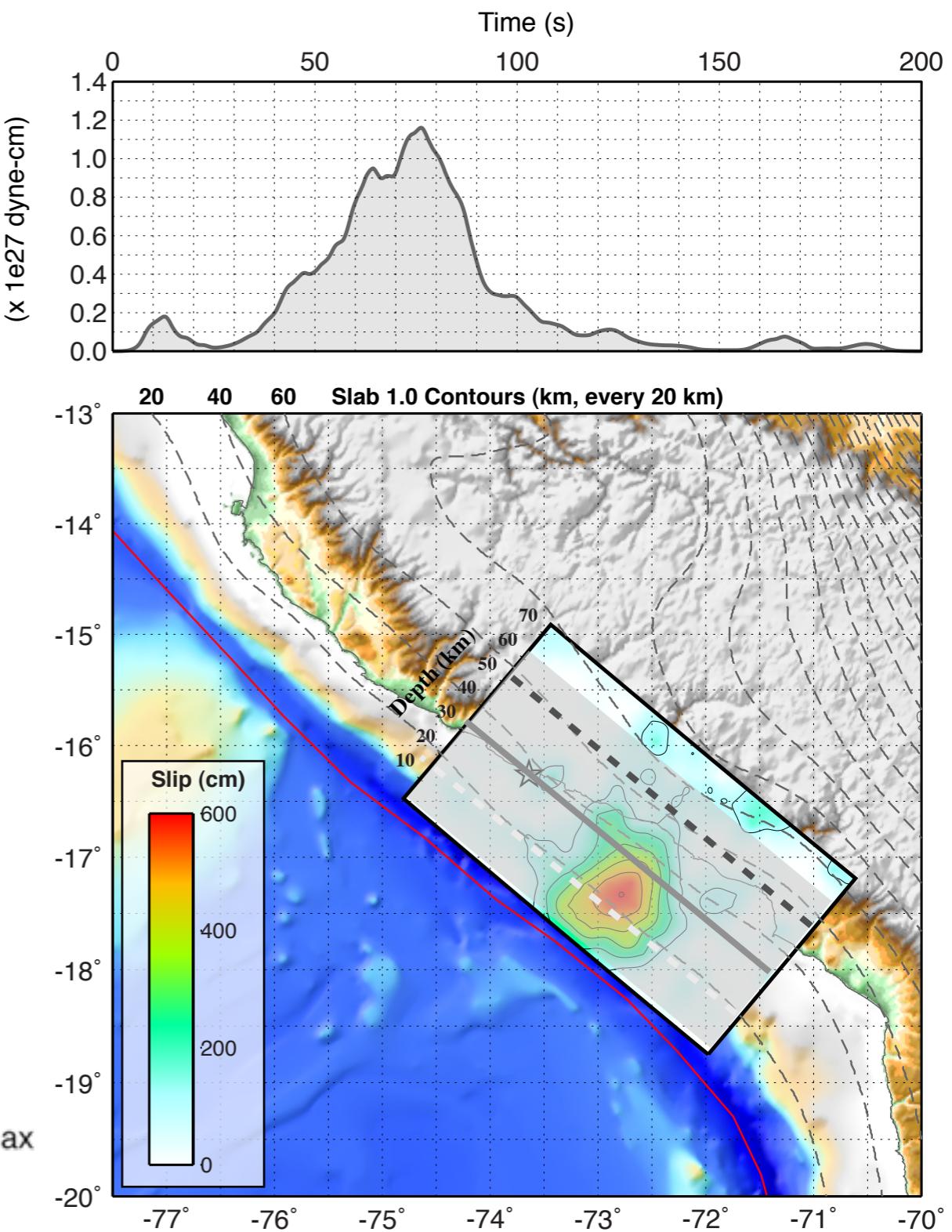
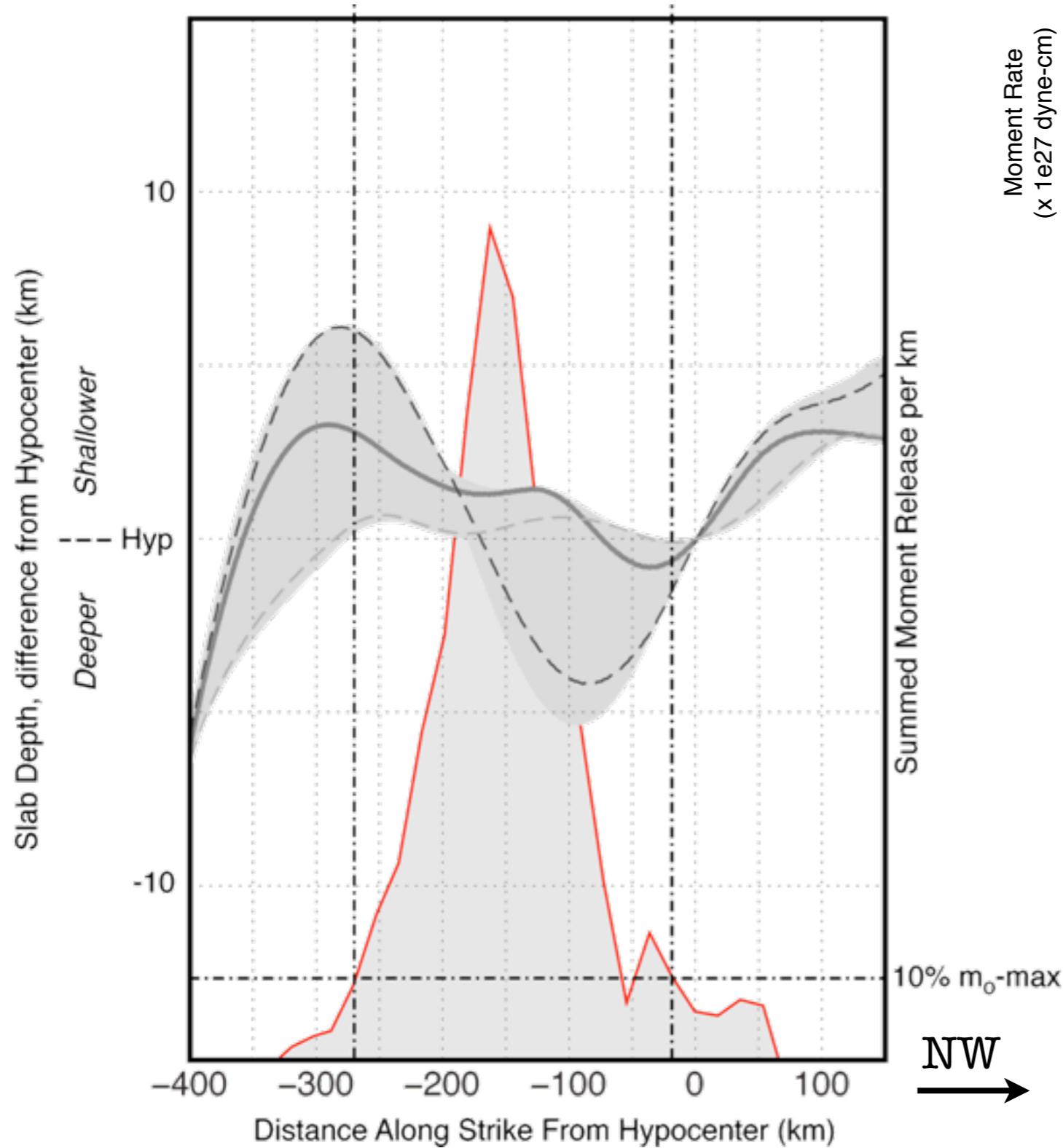
FFM vs Slab

Peru 2001



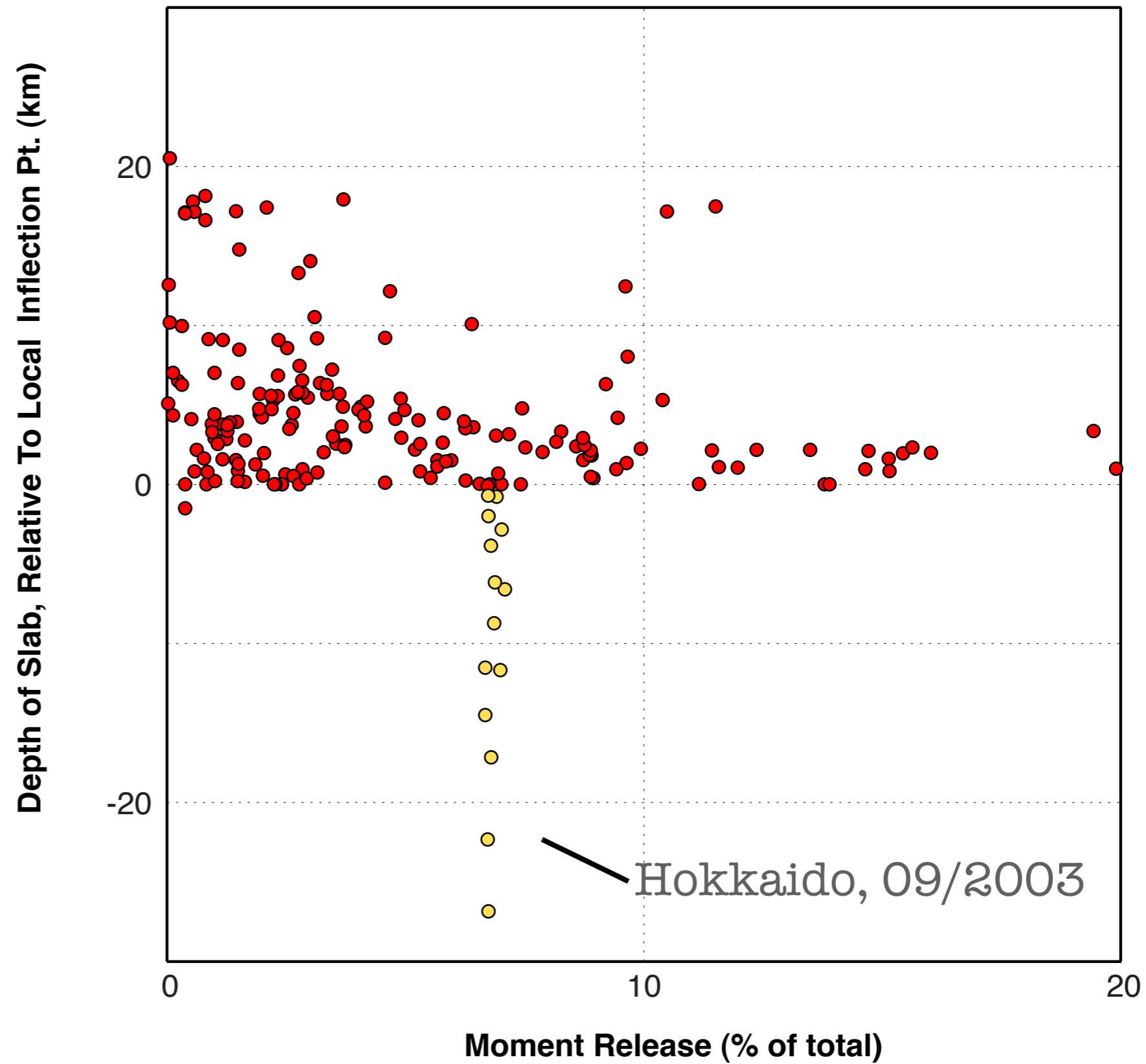
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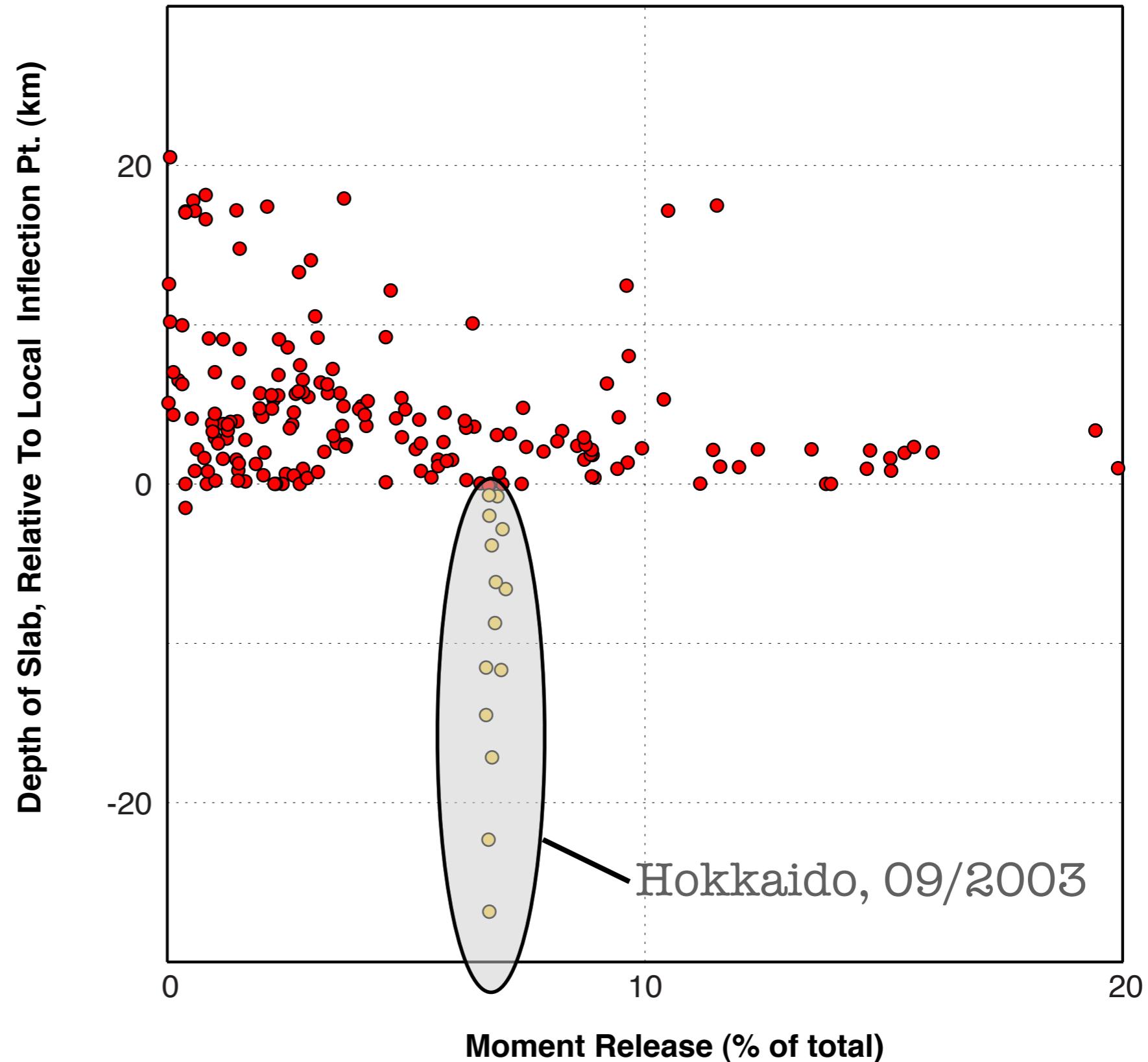
Slab1.0 vs Moment Release - Summary

With the exception of the 2003 Hokkaido earthquake, all events studied show correlations between rupture area (moment release) and local depressions in the slab surface.



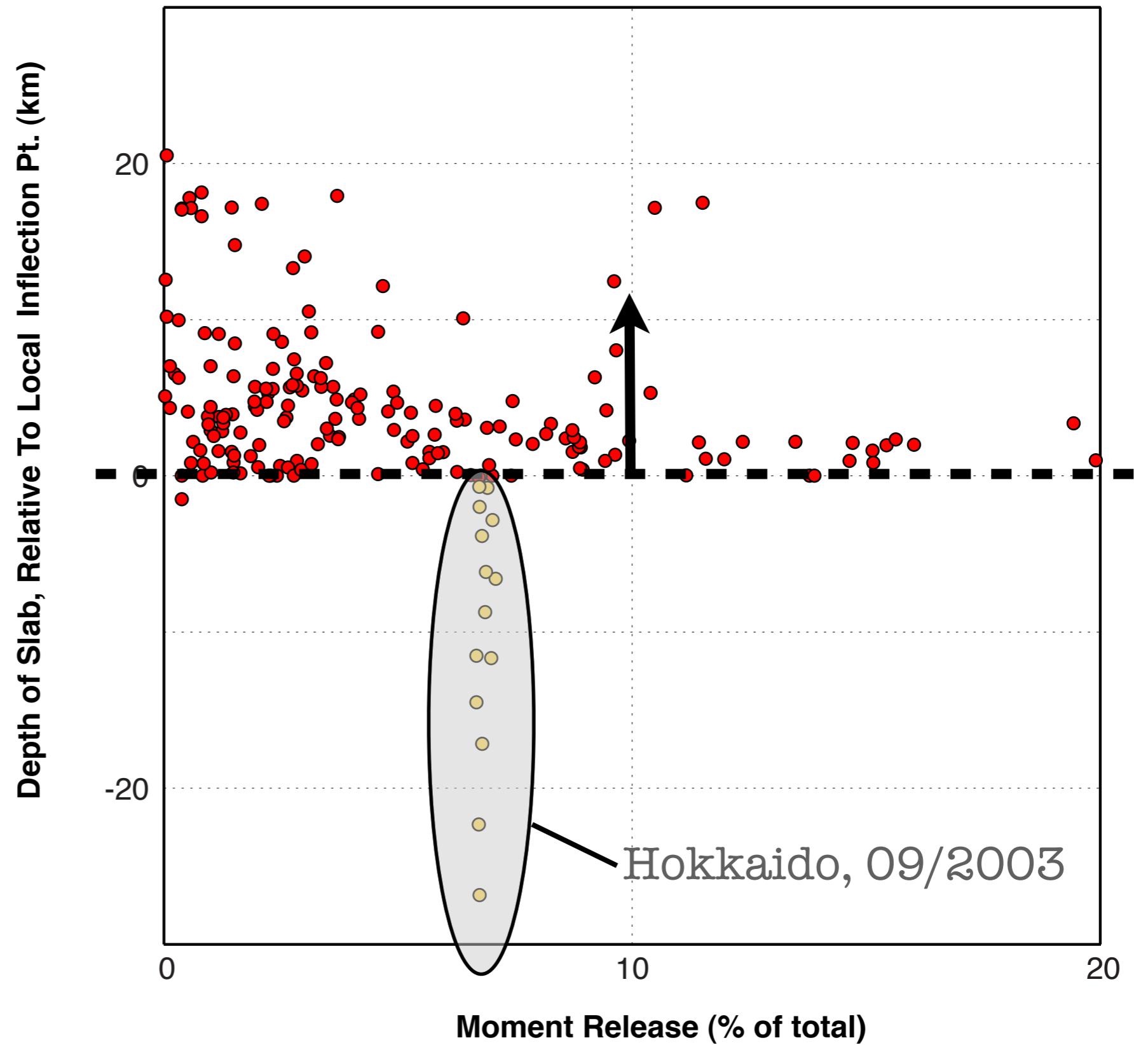
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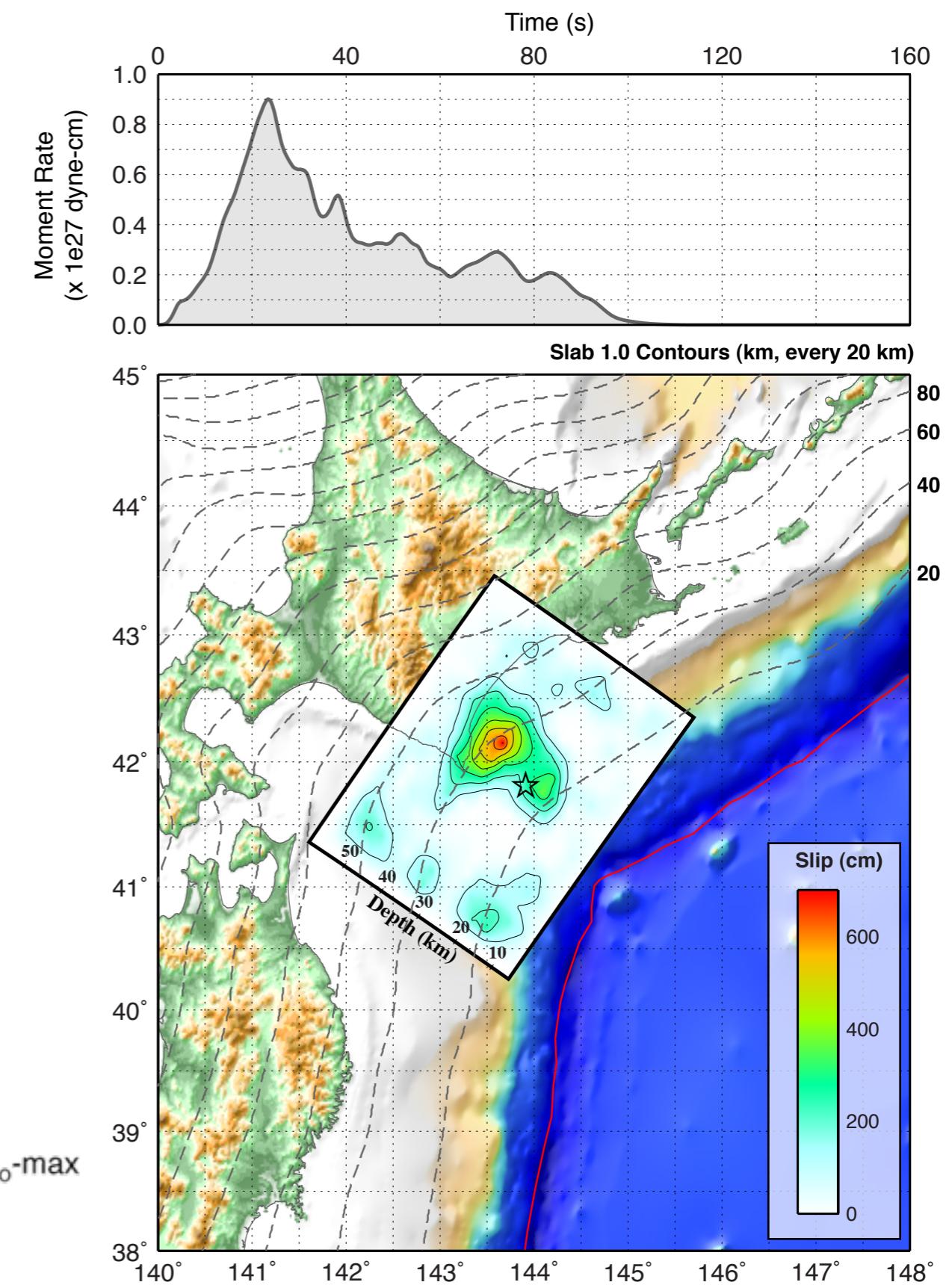
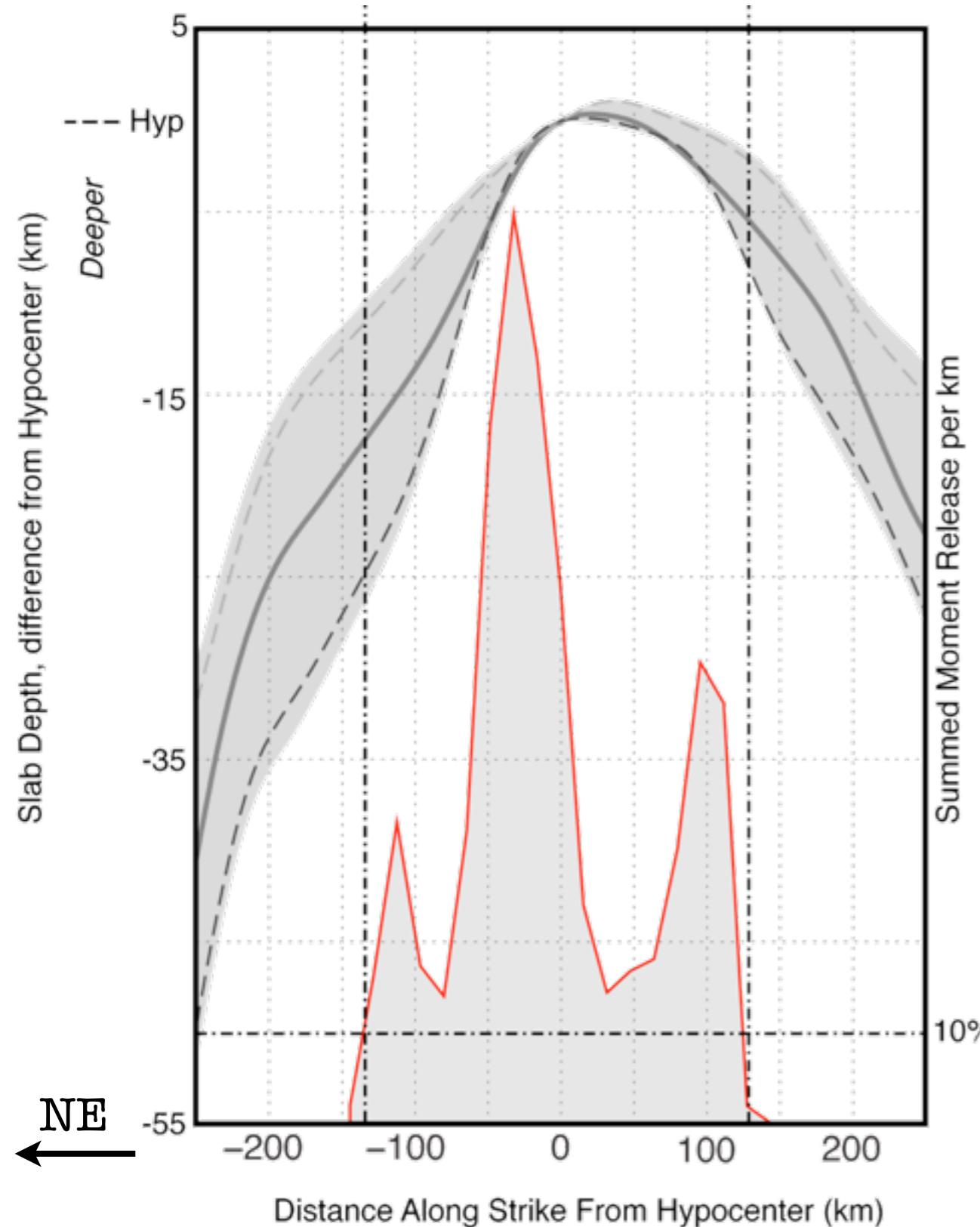


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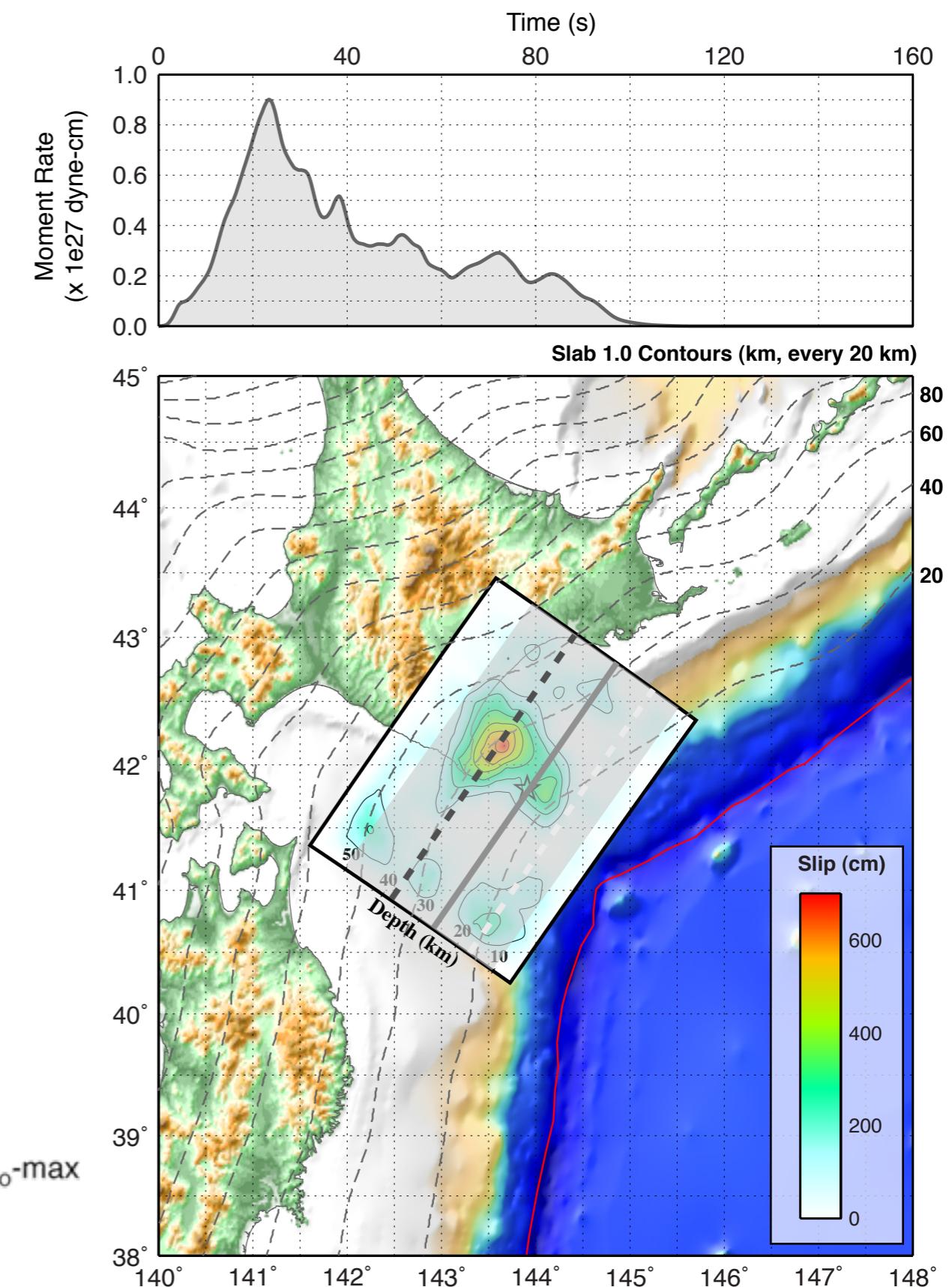
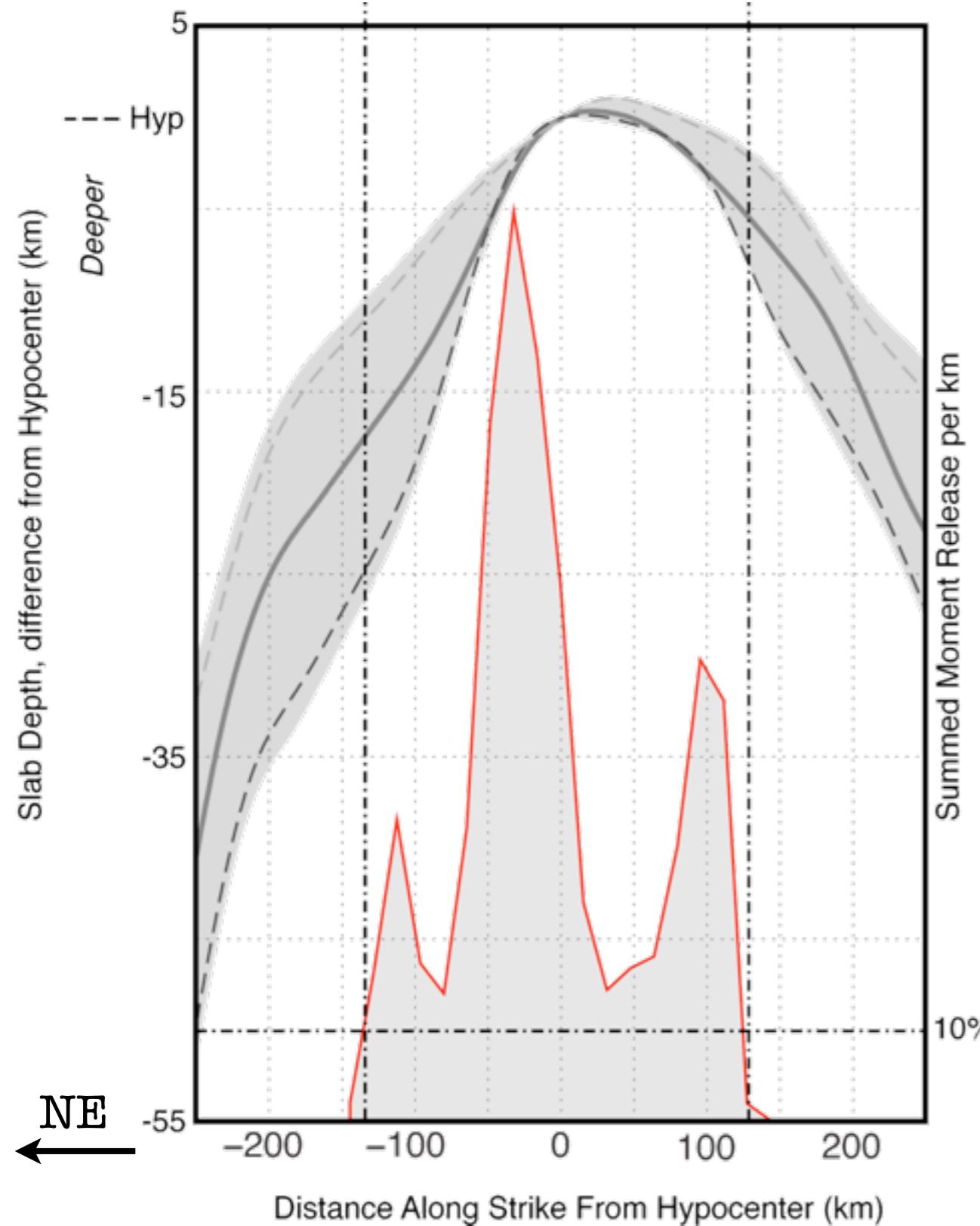
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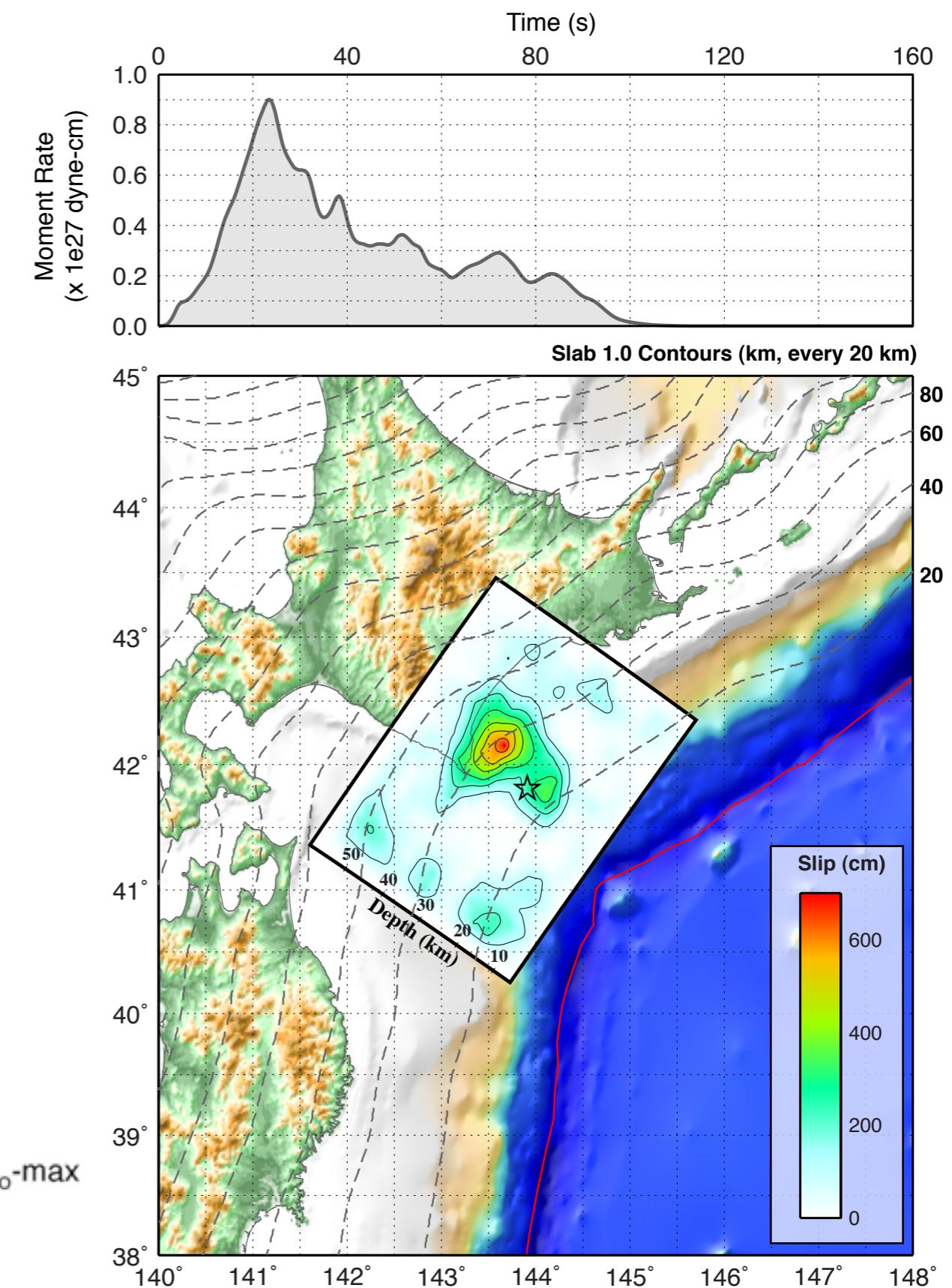
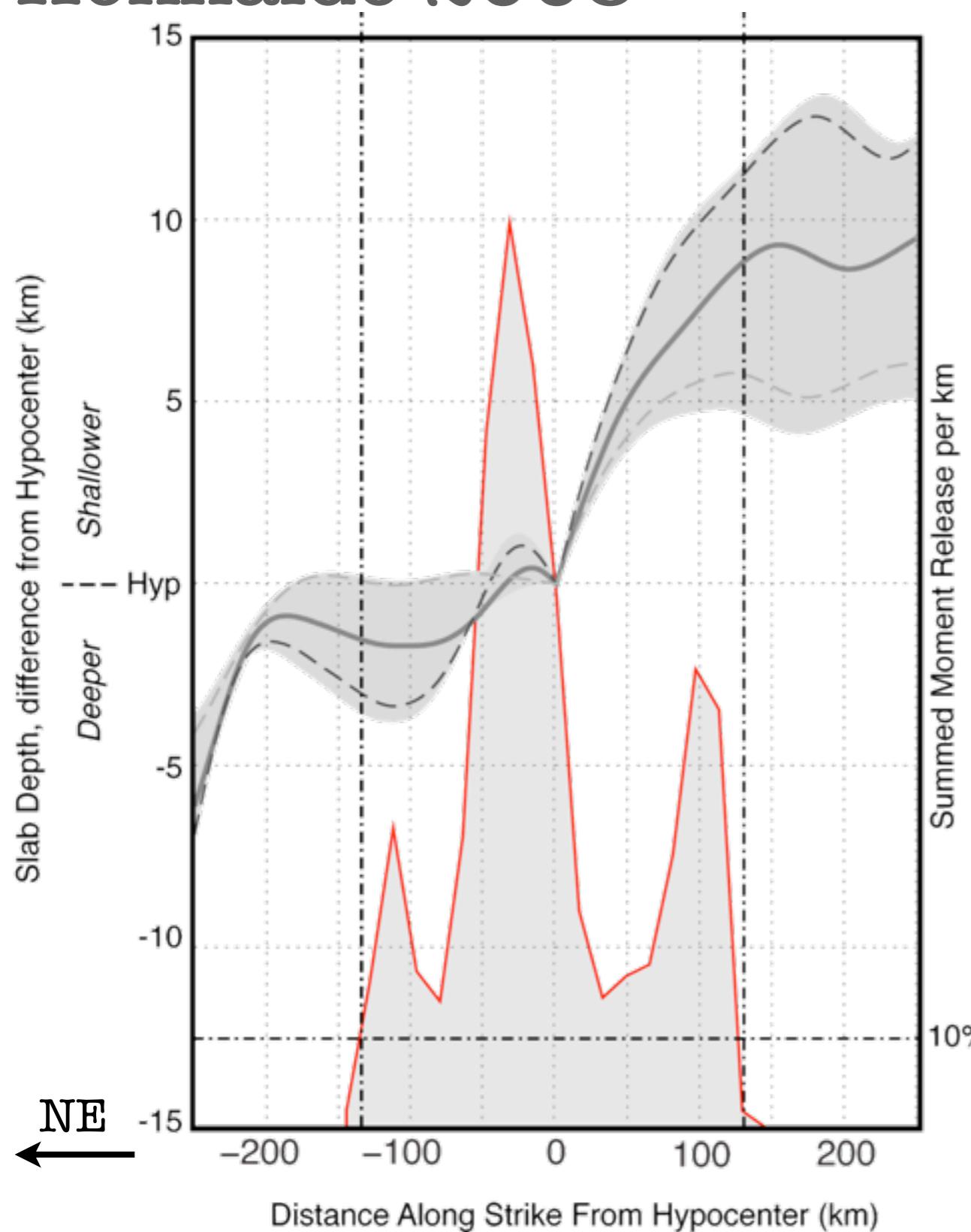
FFM vs Slab Hokkaido 2003



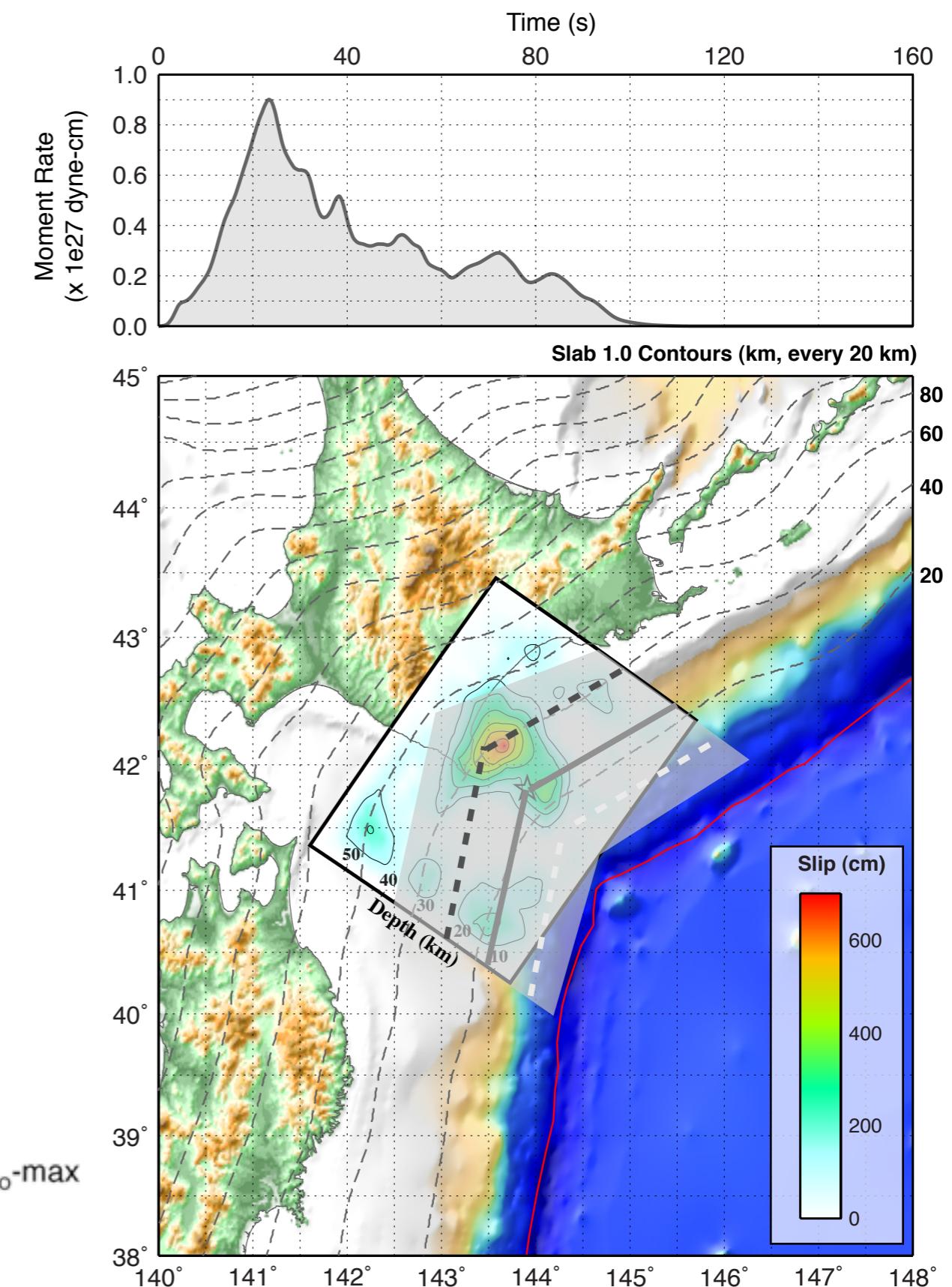
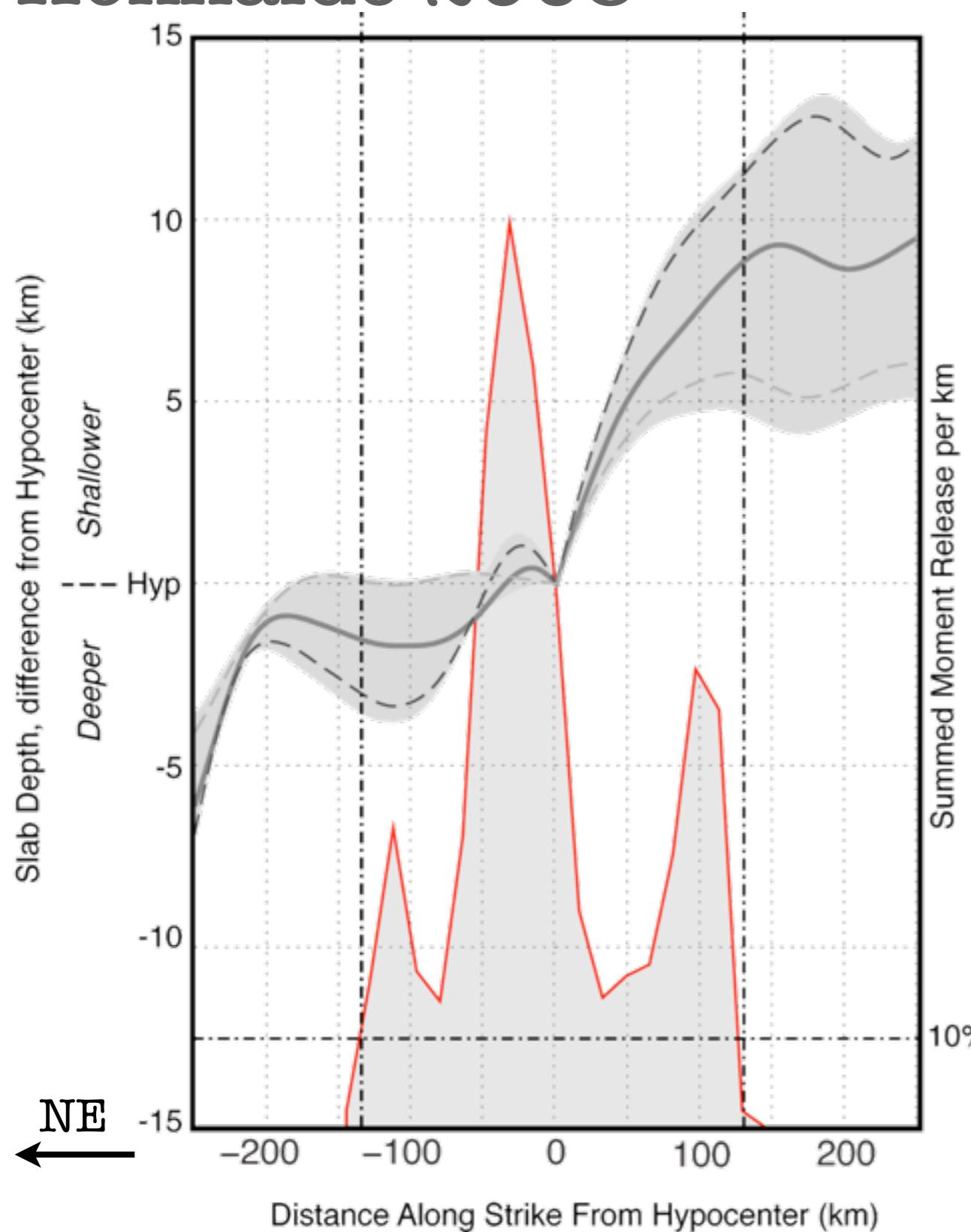
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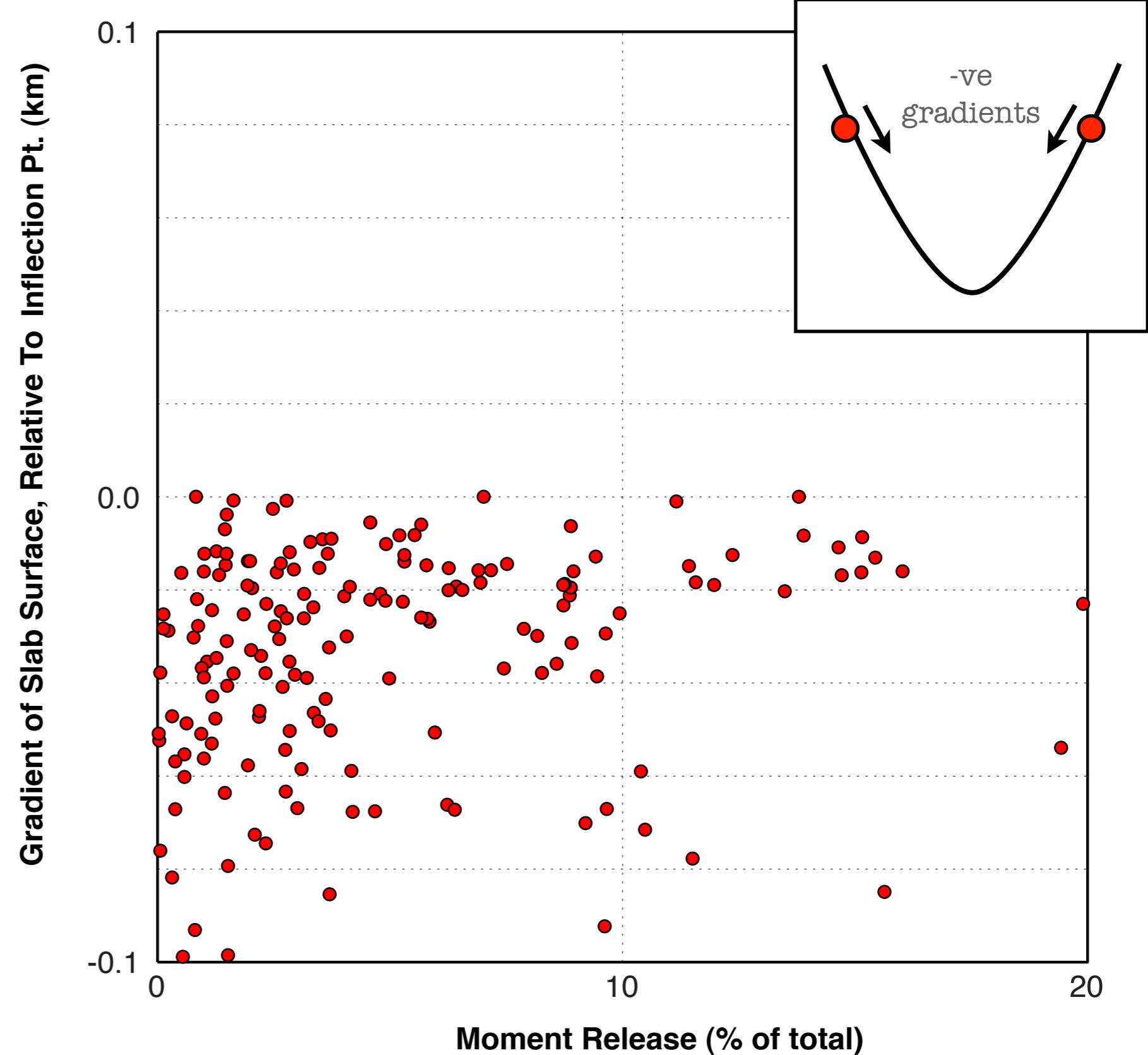
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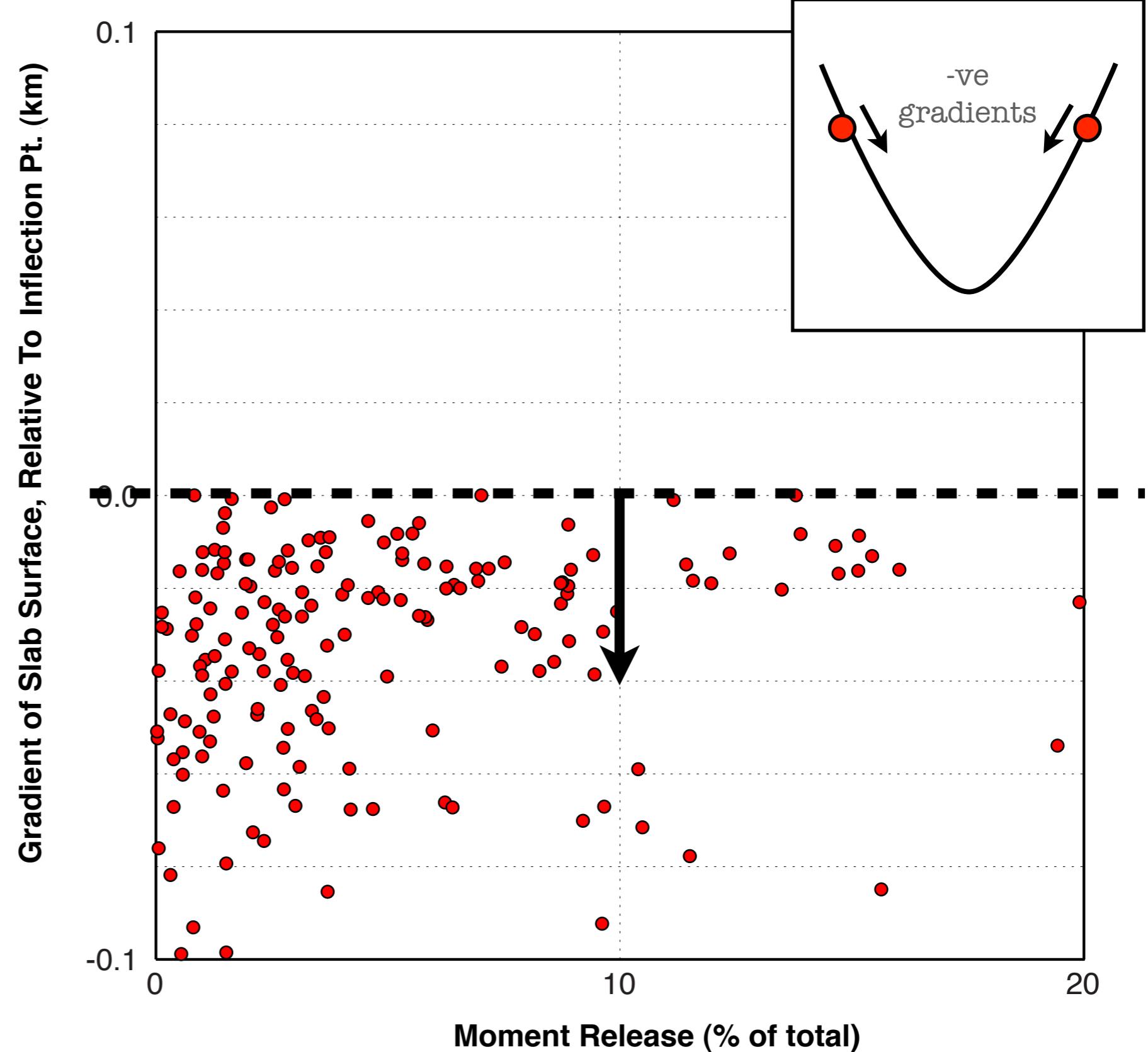
Gradients of slab surface show same pattern (all negative relative to local minima).



Slab1.0 vs Moment Release - Summary

All events studied show correlations between rupture area (moment release) and local depressions in the slab surface.

Gradients of slab surface show same pattern (all negative relative to local minima).



Discussion

Moment release during large/great earthquakes of the 21st century spatially correlate with regional depressions of their subducting slabs.

Why?

--> Correlation does not imply causation, but the observation is intriguing.

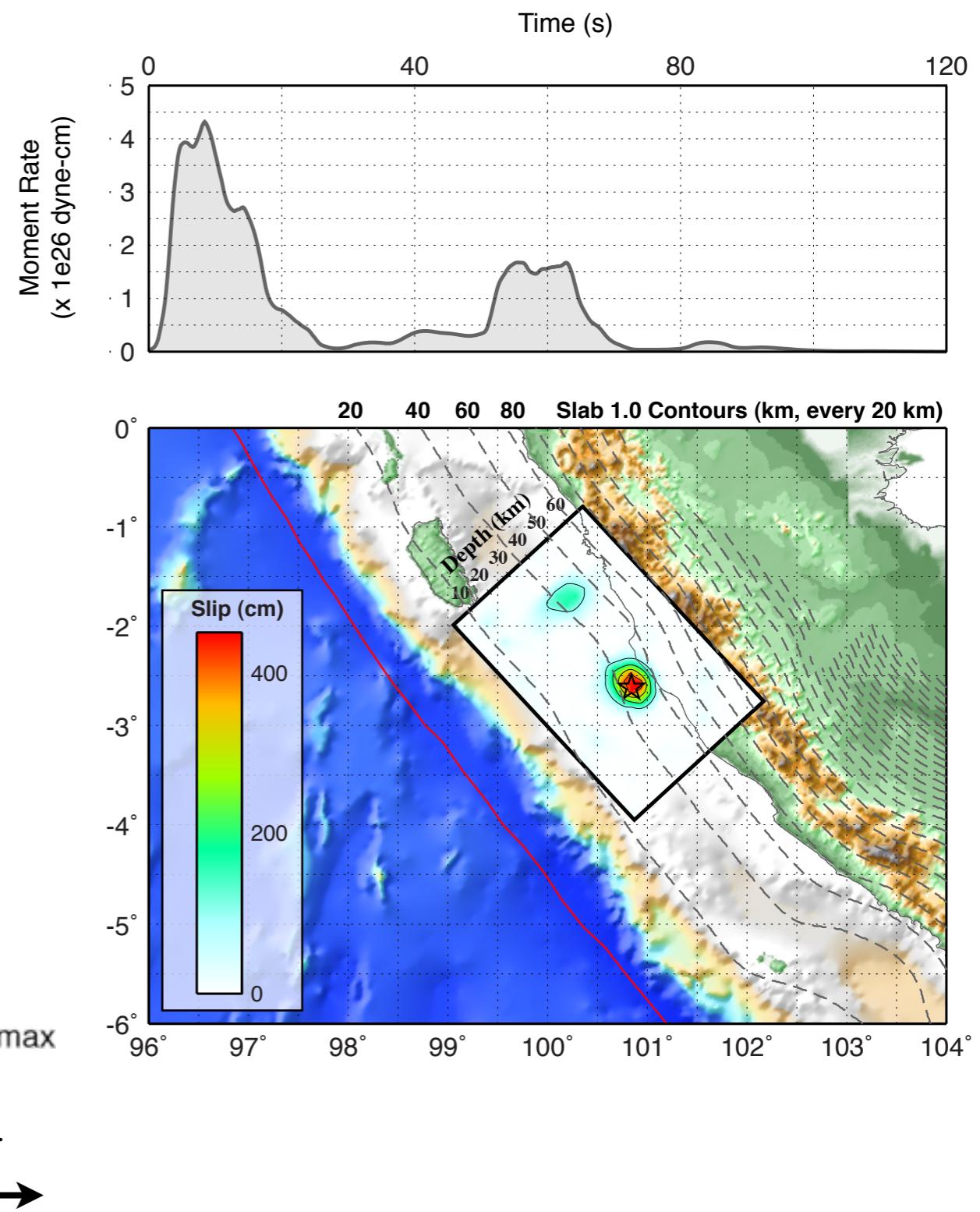
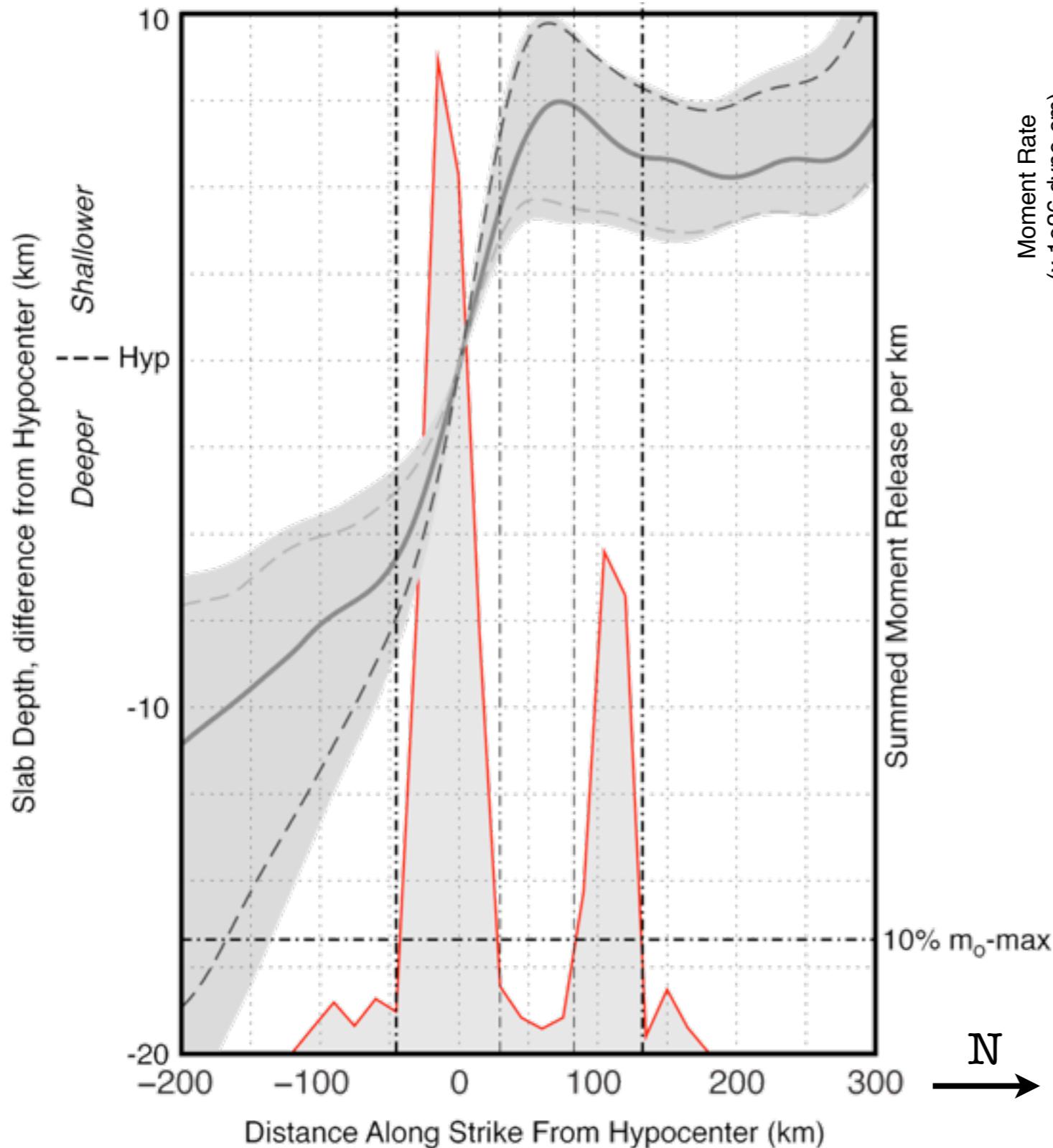
- Do these regional depressions correlate with areas of high coupling from GPS studies?
- Do they correlate with over-thickened subduction channels/sediment fill? Areas of low friction => promoting rupture propagation?
- Are these depressions active interseismically?

If we can map out regional depressions from subduction zone geometry models, can their frequency & size tell us anything about EQ hazard?

Extra Slides

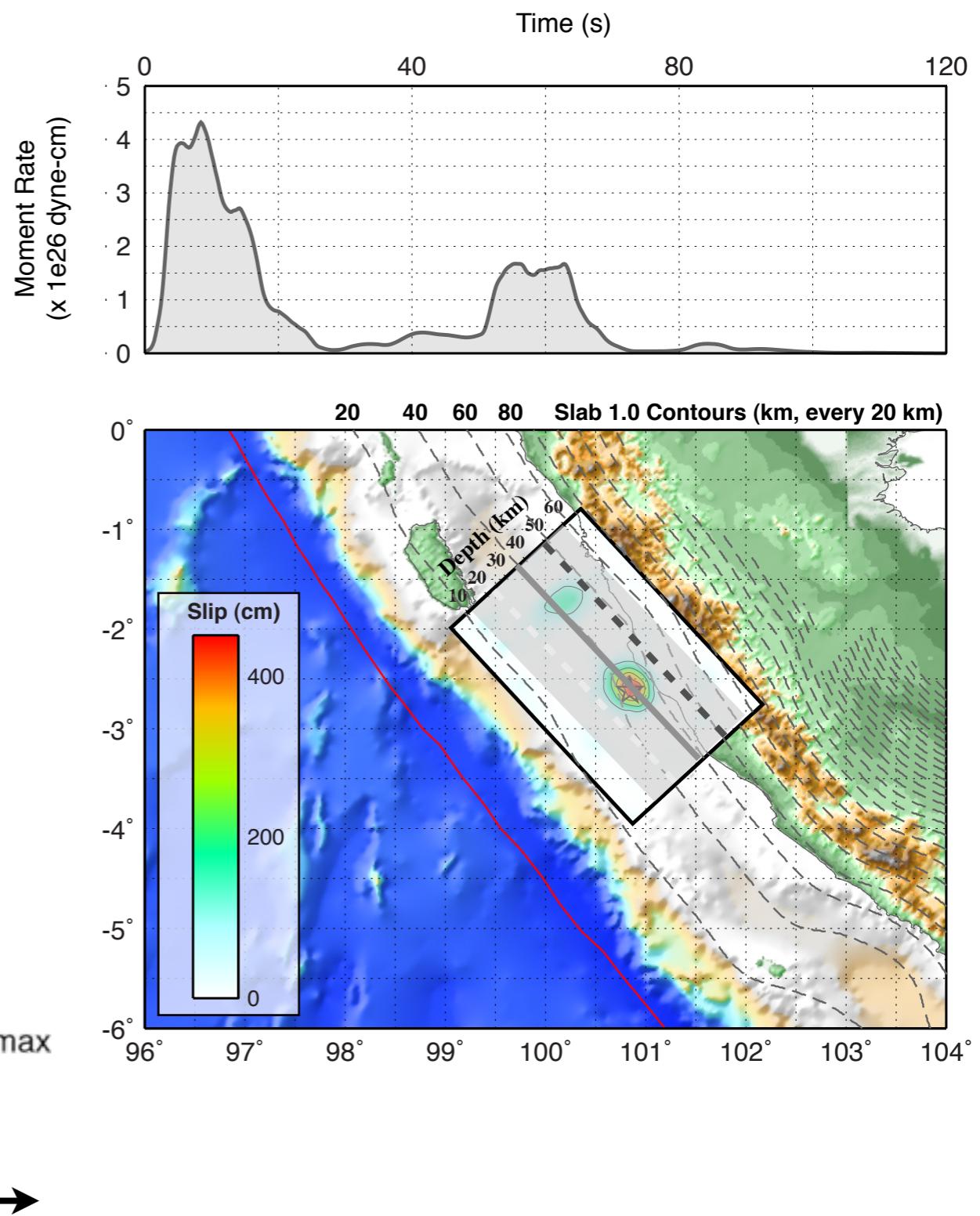
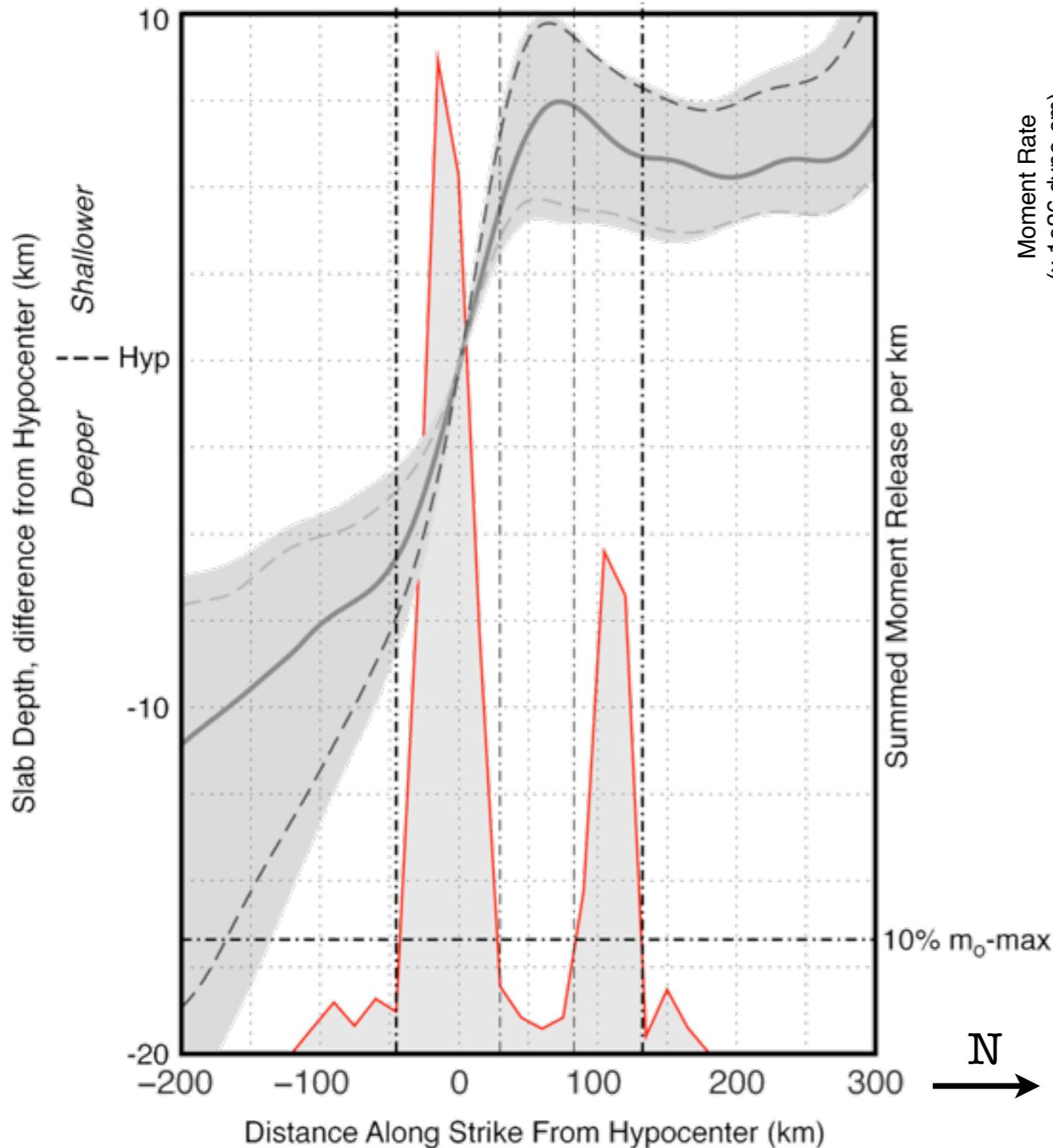
FFM vs Slab

Sumatra 2007 (09/12b)



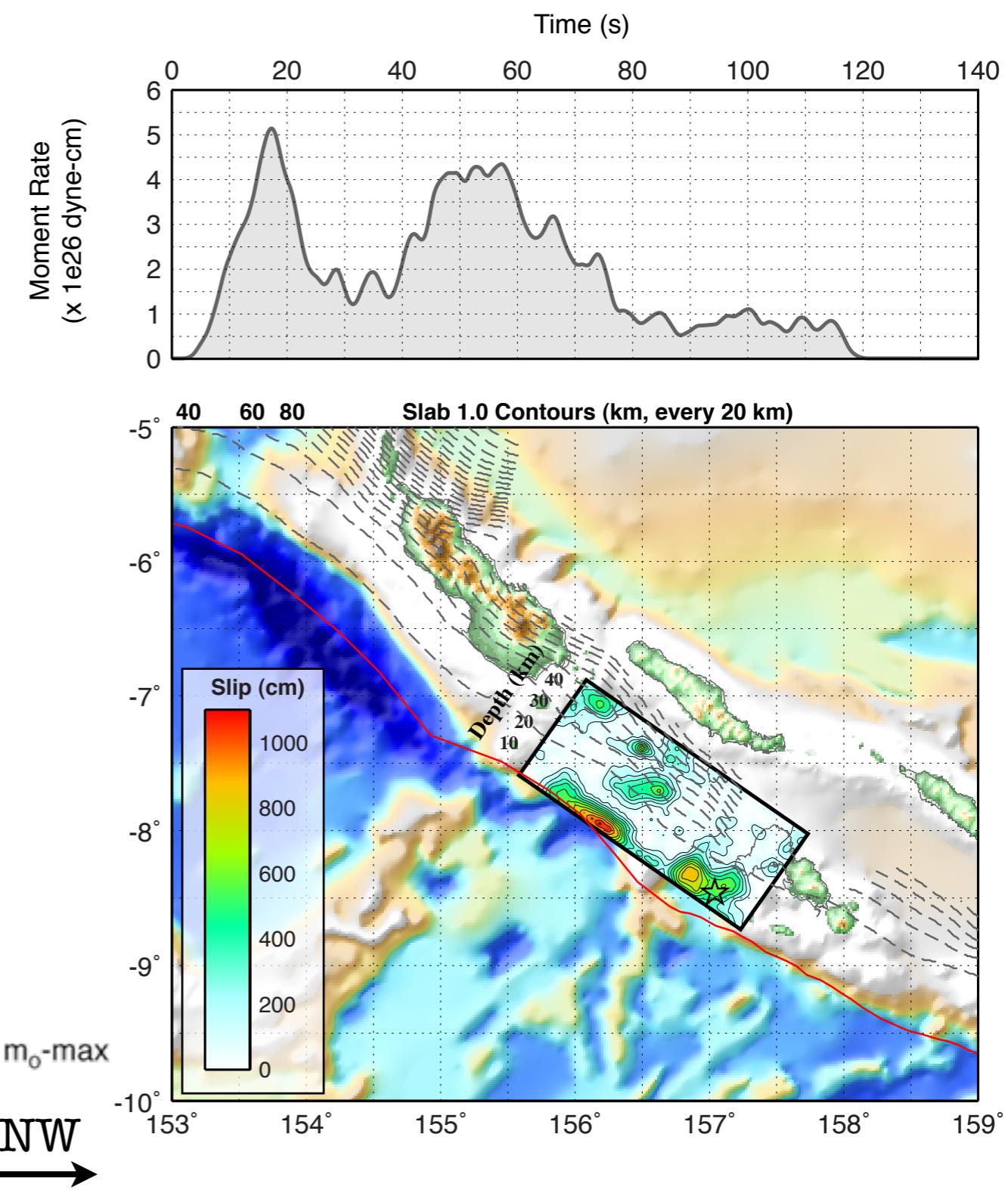
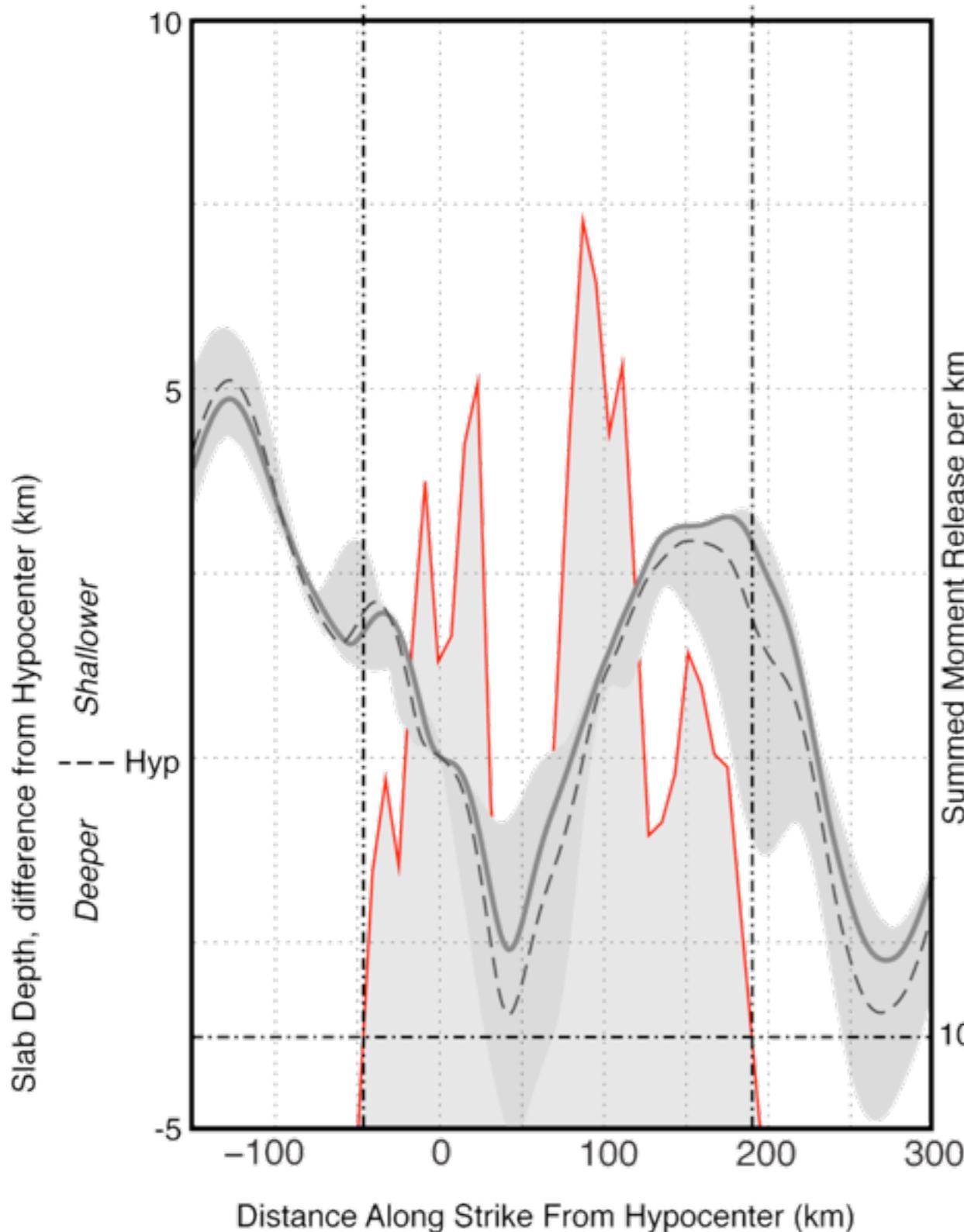
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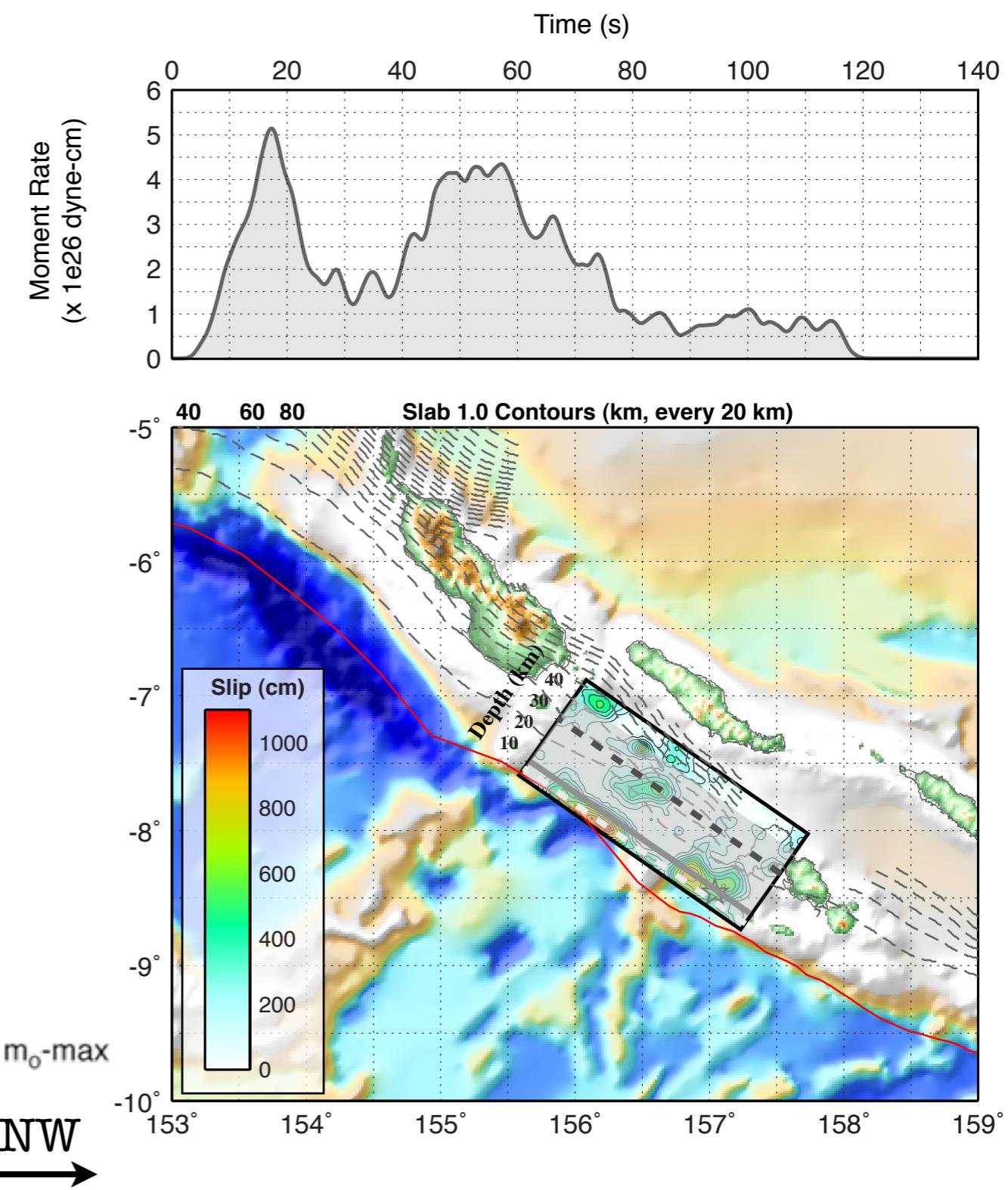
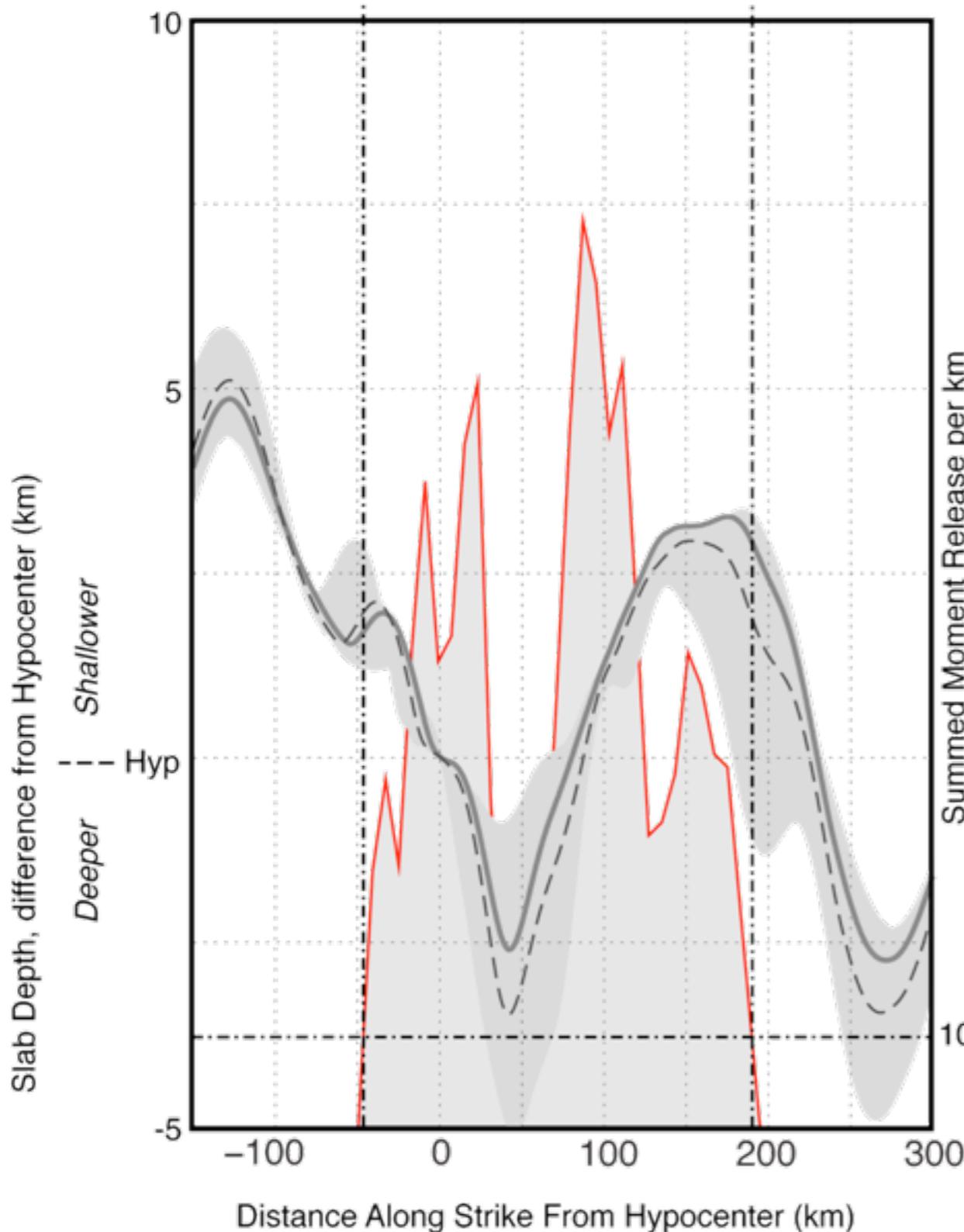
FFM vs Slab

Solomons 2007

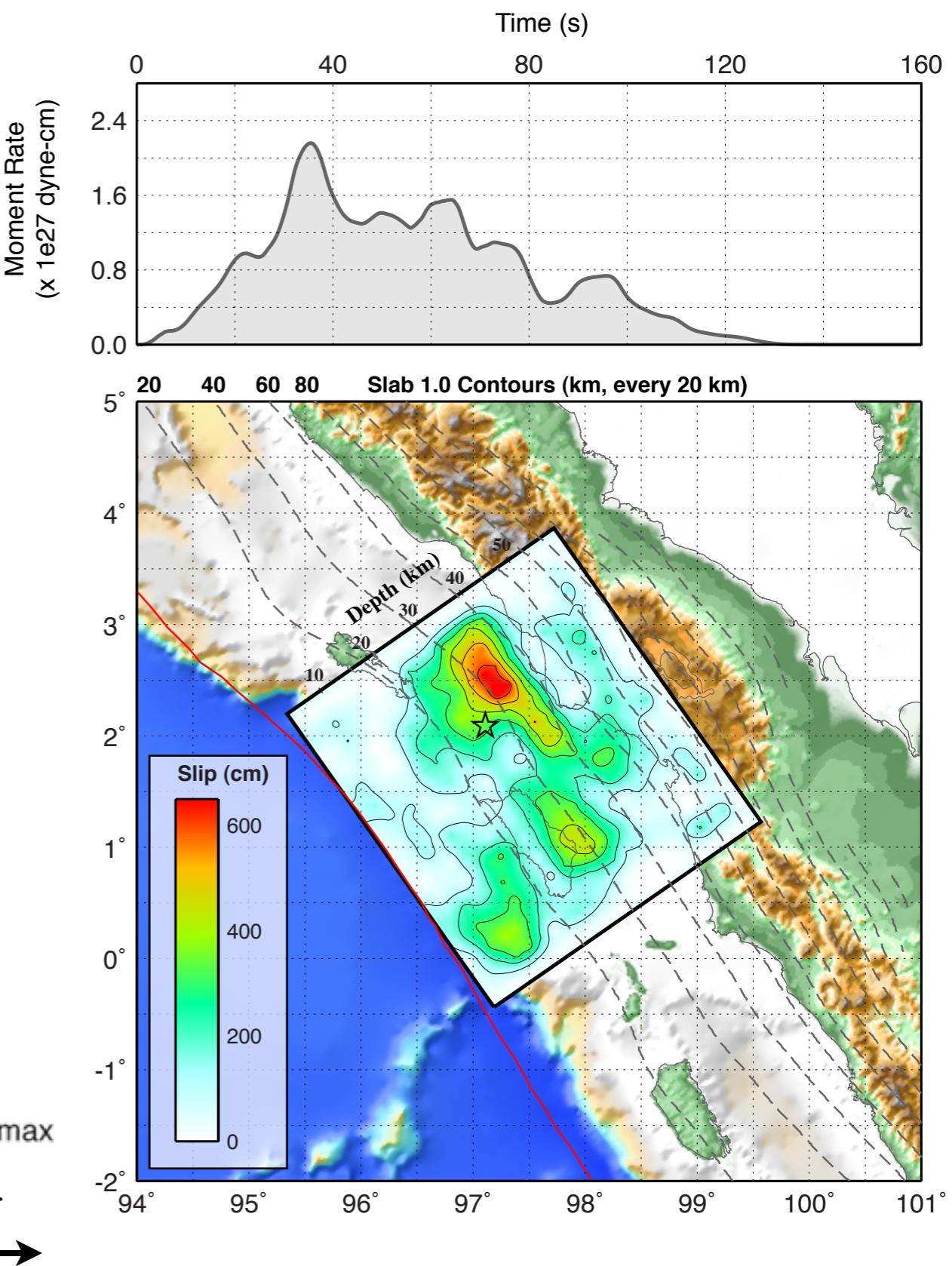
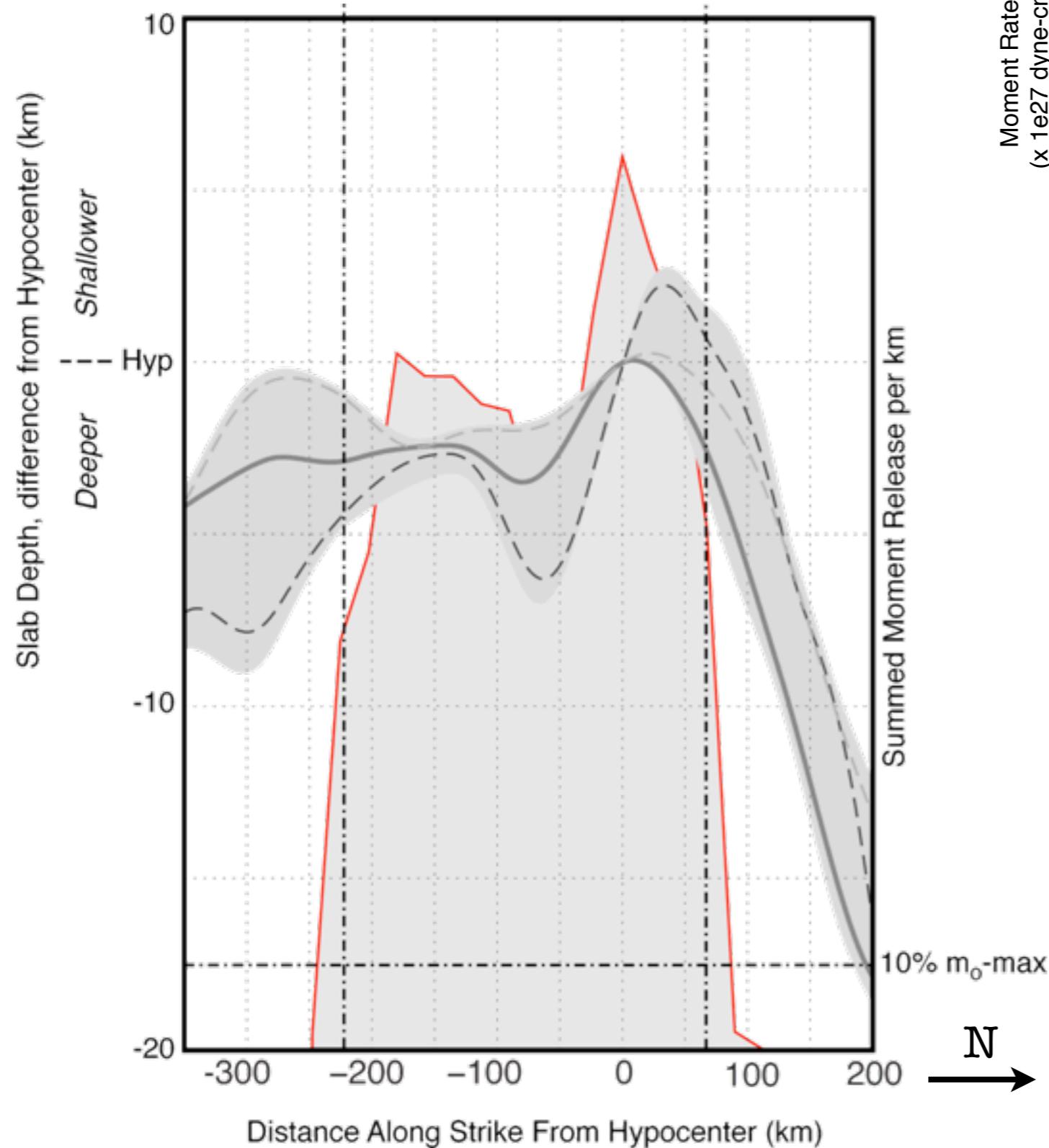


FFM vs Slab

Solomons 2007



FFM vs Slab Sumatra 2005



FFM vs Slab Sumatra 2005

